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CO-ORDINATION OF THE NATION'S RESOURCES

RECENT debates in the House of Commons on man-power and production have indicated an increasing concern with the direction and co-ordination of our economic effort. The announcement that Lord Stamp has reported to the Prime Minister that the work of surveying economic and financial plans which he undertook with the assistance of Mr. H. G. Henderson and Prof. Henry Clay can now be brought to an end, suggests that a definite stage has been reached in this matter.

There are, of course, fields in which economic affairs, as in that of economic warfare, overlap with considerations of offensive warfare itself; with our comparatively limited resources of man-power its apportionment between war production, essential services, civil defence and those of the highly mechanized armed forces is no simple matter. Without, however, a clearly defined policy and accurate knowledge, waste and overlapping are almost inevitable.

Of the danger of departmentalism the Ministry of Aircraft Production provides a sufficient illustration. Despite the wonders Lord Beaverbrook worked last summer in accelerating the production of fighters, his methods have as conspicuous defects as merits. Refusal to co-operate or co-ordinate, and war with other departments as well as on the Nazis, are no service to our total effort when they upset the programme of other departments. Moreover, the administrative task is not simply that of balancing or co-ordinating rival demands. It involves the harmonizing of the policy as well as of the programmes pursued by such closely related departments as, for example, the Ministry of Food and the Ministry of Agriculture, or for another example, of the Ministry of Food and the Ministry of Health.

When departmental decisions or policy may affect not only the internal efficiency or purposes of that department but may even impair or frustrate the programme and policy of another independent department, some co-ordination and guidance from above is clearly demanded. Nor is this the whole difficulty. Our economic policy or strategy must have regard not merely to affairs in Great Britain but also to the economic position of the Dominions and Colonies, and of our allies and well-wishers in other countries. Nothing less than the maximum and most efficient use of the full economic resources of the whole Empire will suffice for our success in this struggle.

There have already been reminders of these interactions from time to time as restrictions have been placed upon imports of foodstuffs or other commodities. The recent decision of the Government to reduce or prohibit imports of fresh or canned fruit are a pertinent example that such matters do not end with our own self-denial. From the point of view of conserving shipping tonnage these may be wise precautions, but their reaction on the countries thus deprived of their markets, such as South Africa and Jamaica, may have a significant effect on the economic front of our total war effort.

Jamaica, for example, is one of the poorest of the British West Indian Colonies, and her poverty will be desperately increased now Great Britain is no longer to take her bananas, which normally account for half her total exports and were almost entirely imported by Great Britain and the now blockaded countries of Europe. A disastrous hurricane and the spread of disease had already badly affected the

banana trade last year, and exports in the first half of the year were only a fraction of what they were a year earlier. While the trade has no more than meagre reserves, sugar-rationing has blighted Jamaica's only hope of expansion in an alternative crop, and a food production scheme launched a few months ago has been hampered by the absence of sufficiently attractive prices and by unemployment among the middle classes providing the market for such new output.

This situation can scarcely be ignored by the Secretary of State for the Colonies in view of the recommendations of the Royal Commission on the West Indies which the Government has already accepted, and the policy to which we have been committed by the inauguration of the new Colonial Development Fund. The restriction of these food imports therefore may well involve increasing the substantial British financial help to Jamaica as well as exploring the possibility of outlets for her produce in the Dominions and the United States. Other parts of the Colonial Empire which have been responding so splendidly to the call of the Motherland may also require financial or other help in similar ways as a repercussion of restrictions at present imposed by us on their markets.

The matter is, however, one which has a direct connexion with the plans which the Ministry of Economic Warfare is already formulating for the management of the great surpluses of food and raw materials now accumulating in different countries. These plans are concerned with the problems that will face us when the War is over: the task of meeting the immediate needs of Europe. Within the boundaries of the Empire it should at least be possible to consider them in relation to the financial and economic needs and resources of the Empire at war, and to minimize the dislocation and distress occasioned by the disruption of the individual economy of Colony, Dominion or Motherland under immediate exigencies. Wisely conceived with a view to such policies, the work of the Interdepartmental Committee, of which Sir Frederick Leith-Ross is chairman, appointed by the Minister of Economic Warfare, might well provide the Minister of Food or other colleagues with valuable data enabling them to achieve their own ends with less friction or dissipation of colonial and imperial resources.

This is indeed yet another field in which planning to meet post-War problems may assist in the solution of those of a war-time economy. The Interdepartmental Committee has clearly a double function. Its purpose is to mitigate present embarrassments of overseas producers deprived through the War, whether by the British blockade, food policy or in other ways, of many of their normal markets, as well as to prepare in advance for the relief at the earliest possible moment after their liberation of the plundered countries the resources of which are being ruthlessly drained to serve the Nazi war machine. It should not be forgotten that the appointment of this Committee brings a message of hope to the inarticulate victims of Nazi depredations. Effective publicity in these unhappy countries for the work on which the Leith-Ross Committee has embarked might be far more valuable to the British cause than a premature statement of war aims, and in itself provide a most effective answer to the challenge of the new order or regulation through Nazi domination in Europe which has been so blatantly proclaimed.

The problems which confront the Committee are indeed complex, and the statement on economic warfare broadcast a short time ago by Dr. Hugh Dalton to the United States was framed to invite the co-operation of the United States. While the most immediate problems are those of finance and storage, the eventual problems of shipping and distribution call for consideration in advance, in the light of the experience accumulated after the armistice of 1918. Exact conditions cannot be forecast, but some broad estimate of needs and the points where they are likely to be most acute should not be impossible.

Nor is this all. The problems of future production also intrude themselves. Beyond the immediate needs of Europe lies the larger task of constructing a scheme for co-operative planning which will put an end to the gross inequalities between people and people, man and man, that are the disease of our modern life and the cause of much of our economic confusion. If, indeed, we can solve this problem of surplus production, we may break down the system of high tariffs and other restrictions.

The issues with which the Committee is dealing have indeed more than passing significance. They impinge directly on the world-wide problem of bridging the gap between producer and consumer, of co-ordinating the different types of production suited to different regions and of planning distribution and exchange. As Dr. Dalton put it, we must finish with the economics of scarcity and anarchy; we must build the new economics of plenty founded on a rational plan. To extend the immense productive reserves of the world both to

relieve poverty and to create a new standard of living, and in so doing to lift the spectre of unemployment from millions, is a constructive task in which we may well look for the comradeship of the American people.

None the less it is true that along such lines our own efforts should assist eastern Europe to build a life less exposed to the rival ambitions of great Powers and less distracted by the animosities of race. With the breakdown of high tariffs and other restrictions and the use of our common resources to develop the economic life of the poorer States by expenditure on roads and transport, education, co-operative institutions, and schemes of nutrition, eastern Europe should acquire a well-balanced economy in which primary production and industrial expansion are complementary. If we can put courage and imagination into our schemes for reconstruction, democracy, by rescuing eastern Europe, may at once attest its own vitality and superiority to the dictatorships and its claims on the help of the American peoples in these even wider constructive schemes inherent in a world economic plan. Whether indeed we face the immediate problems of our own war-time economy, calling for single-minded direction and co-ordination through a Minister of Economics, or their impingement on the immediate post-war problems confronting the Leith-Ross Committee, the need is for the vision, courage and creative statesmanship which are the secret of every major advance of man.

RECENT TRENDS IN PSYCHICAL RESEARCH

Experiments on the Paranormal Condition of Drawings. By Whately Carington. **Fresh Light on Card Guessing.** By S. G. Soal. *Proceedings of the Society for Psychical Research*, Part 162, June 1940.

The Ultra-Perceptive Faculty
An Experimental Investigation. By Dr. J. Hettinger. Pp. 204. (London: Rider and Co., n.d.) 12*s.* 6*d.* net.

IN the course of the last few years, a change has become apparent in the attitude of serious students in psychical research, not only as regards the nature of the problems with which they are called upon to deal, but also as to the methods by which those problems should be tackled. As progress is made along the whole scientific front, so new methods, devised for specific problems, can often be turned to account in dealing with points the elucidation of which was not envisaged when the novel means of attack were first planned.

The problems of psychical research, as is now sufficiently well known, can be roughly but conveniently divided into two main groups, which are generally called the physical phenomena and the mental phenomena. The former class comprises such occurrences as telekinesis, materializations, apports and such-like; whilst the latter consists of the subjective or psychological manifestations concerned with the various automatisms, trance mediumship and the host of varied occurrences which have often been associated with a supposed telepathic or clairvoyant faculty.

As regards the physical phenomena, it can be said with some degree of truth that very little progress has been made during the last fifty years. Indeed, during recent times frauds and mystifications have become so frequent, and the incompetence and disingenuousness of certain investigators so marked, that many students have turned away in disgust and concentrated all their attention upon the psychological side, where better control conditions can often be secured.

Apart also from the dubious nature of the physical phenomena themselves, the difficulties of obtaining repeatable experiments have proved almost insuperable; and thus accounts of these manifestations have remained on the anecdotal plane, to be appraised for what they are worth, but often of little real interest except for those who view them from the historical or anthropological aspects.

The Society for Psychical Research has always been keenly aware of these weaknesses and difficulties, and so far back as 1883 Prof. F. Y. Edgeworth contributed a paper to the Society's *Proceedings* in which he dealt with the calculus of probabilities applied to this subject. Again, in assessing the value of the successes in the card-guessing experiments conducted by the late Mrs. A. W. Verrall about 1890–95, the formulæ for calculating probability were used by Mr. C. P. Sanger; and for some years afterwards it was always felt that some method for estimating chance factors was urgently needed when dealing

with questions in which telepathic and clairvoyant factors seem to have been indicated. It was not, however, until 1928 that Miss I. Jephson published a paper in the Society's *Proceedings* in which she described the results of a series of card-guessing experiments. Although perhaps her data were not sufficiently controlled, her methods of dealing with them had much to recommend them. Statistical theory and technique had progressed since 1890, and Miss Jephson availed herself of the methods of scoring coincidences in tests with playing cards which had been devised by Prof. R. A. Fisher about 1924, and afterwards modified by him in view of the problem presented by the card preferences exhibited by certain persons who offered themselves as subjects for experiment.

The scoring technique devised by Prof. Fisher not only furnished a score where a guess is correct but also a score for a partially correct guess. Thus if the actual card is the ten of clubs and the ten of spades is guessed, then there is a greater degree of success than if the percipient had guessed the queen of hearts. This development of the statistical method as applied to the problems of psychical research is now rapidly proceeding and bids fair to occupy the centre of the controversial stage for some years to come. The turmoil aroused in psychological circles in the United States concerning the question of what has been called 'extra-sensory perception', as formulated by Dr. J. B. Rhine and his colleagues at Duke University, is now becoming crystallized around fewer points, since the attacks on the statistical technique employed have almost entirely failed and the great improvement, both in the soundness of the data and their presentation, have led to a general tendency to view the whole question in a more favourable light.

It is the feeling that psychical research, in order to produce more fruitful and reliable results, must employ quantitative methods to a far greater extent than hitherto, which has inspired the work of Messrs. Carington, Soal and Hettinger, bibliographical details of which can be seen above. How far, it may be asked, are the 'coincidences' so frequently met with in this subject 'real' coincidences, and how often might they be said to happen 'by chance'? Can we obtain a probable chance-frequency by which the results can be judged? Do the figures, if they can be obtained at all, show significant results, or merely a result which, judged purely from the statistical point of view, can certainly be ascribed to what we call 'chance'? In other words, the problem is one where we have to ask ourselves whether the data provided by certain branches of psychical research are analogous, or can be made analogous in all important respects, to those other fields of research where the statistics of probability are generally accepted, such as in questions arising from the consideration of games of chance or experiments depending upon random sampling and such-like.

In the case of the three authors now under review, the claim is made that experiments have been devised which exhibit significant results, and show clearly that something other than the chance factor is present. In all three cases the most rigorous conditions prevailed, and normal, simple sources of error such as leakage or fraud can, it seems, be safely dismissed. In Mr. Carington's experiments simple drawings were used for the test material. About 250 percipients took part and these were instructed to reproduce the drawings exhibited, normal knowledge of which being, of course, carefully excluded. Other sets of drawings were used as controls, and the scoring was carried out by an independent judge; the results being that the percipients tended to a highly significant extent to score relatively more hits on the original drawings of their own experiment than on the control drawings used in other experiments. A test control scoring of the same set of drawings against a randomized 'dummy' set gave a null result. Moreover, it appeared that the successes were not always of the 'now or never' type, where the hits occurred only on the occasion when the original drawings to which they seemed to refer were displayed. A certain displacement, both earlier and later, was to be noticed, and it was this which suggested to Mr. Soal that he should undertake a re-examination of some of the mass of data on card-guessing which he had collected and which had seemed to yield so little evidence of any non-sensory cognition.

From this examination emerged the discovery that two of Mr. Soal's percipients exhibited in their guesses the same kind of displacement effect remarked by Mr. Carington. Thus in one instance, of 2,000 guesses, the hits on the actual card intended to be transmitted were 447, giving a standard deviation of 17·89 and a value of χ (deviation/standard deviation) of + 2·627; the hits on the card before the actual card, 457 (standard deviation 17·53: χ = + 4·164); and on the card after the actual card, 442 (standard deviation 17·53: χ = + 3·309). In addition to this remarkable effect, of which the interpretation is still obscure, Mr. Soal has shown how the cards before and after the card to be guessed influence the results, thus suggesting that the card images are somehow known to the percipient before they emerge into consciousness.

The psychological implications of these results, which Mr. Soal has discussed in his paper, are

obviously of considerable importance, and suggest that links between normal mental action and what is apparently going on during these obscure processes are already beginning to appear. However that may be, the discovery of this displacement effect may have considerable influence when the results of earlier experiments are assessed, since in these cases the investigators were concerned only with successes on the actual card or symbol exhibited, other guesses being generally neglected or reckoned as failures.

The methods pursued by Dr. Hettinger were somewhat different. In his monograph, which has been approved for the degree of Ph.D. by the University of London, he is at pains to show that modern statistical technique can be applied to statements made by mediums concerning objects submitted to them. In each test the items perceived by the medium relating to the subject with whose article he was dealing were presented to the subject for identification, mixed in some way with an equal number of control items, the subjects not knowing, of course, which was which. Six hundred and twenty-three tests yielded 6,631 items or statements; and of the total 13,262 actual and control items, 4,483 were accepted by the subjects as being applicable to them. Of these, 2,570 belonged to the subjects and 1,913 to the control or fictitious items, the result being calculated as 14·6 times the probable error.

Successful criticism of these results must, it seems, be based upon two main sources of suspected error. An attack can be made on the validity of the data upon which the computations are based; or, if this proves abortive, the statistical technique itself can be criticized. Since this technique is comparatively simple and based on well-recognized principles, an attack in this direction would seem to be somewhat hazardous, and recourse must be made to assailing the validity of the original data, evidence being offered to indicate unnoticed sources of error in their collection and treatment. Considering the extreme care and rigorous scrutiny by experts of every step that has been made in most of these experiments, such a criticism would doubtless be welcomed were it to be forthcoming. But it is in the repetition of the experiments by others and on a large scale that progress can best be achieved. Were such repetitions to exhibit the same puzzling features, then these new methods now being used in psychical research would prove to be fully justified, and we might reasonably expect that this exasperating study has at last turned the corner and is gradually passing from the anecdotal stage to that of a well-founded experimental science. E. J. DINGWALL.

POWER-TABLES

British Association for the Advancement of Science Mathematical Tables

Vol. 9: Tables of Powers giving Integral Powers of Integers. Initiated by J. W. L. Glaisher. Extended by W. S. Bickley, C. E. Gwyther, J. C. P. Miller, E. J. Ternouth, on behalf of the Committee for the Calculation of Mathematical Tables. Pp. xii+132. (Cambridge: At the University Press, 1940.) 15*s*. net.

THIS work is based on a table compiled by Glaisher about 1873, giving the first twelve powers of the first thousand integers. Only one copy of Glaisher's table is known to have survived, and it came into the possession of the British Association Tables Committee in 1935. It is not known how Glaisher computed his table, but it is so accurate that, apart from one missing digit, no error has been found in it.

Glaisher's work has now been largely extended. The present volume gives in full the powers of numbers 1 to 99 up to the 30th; the 31st to 39th and 41st to 49th powers of these numbers somewhat curtailed, the 40th powers in full, and the 50th powers of numbers 1 to 120 in full. For numbers above 100 the range of powers is not so great. The largest number dealt with is 1,099, of which the powers up to the 12th are tabulated.

A table of 50th powers is a majestic sight. The curve $y = 50 \log x$ stands out clearly on the page, shaded in by the digits of the entries in the table. Even 2^{50} has sixteen digits, while 120^{50} is a number of a hundred and four digits. Every fiftieth power is congruent to 0, 1, 249, 376, 624 or 625 to modulus 1,000, and these numbers are seen repeating themselves down the edge of the table. The entries do not go far enough to reveal any higher periodic properties.

For actual reading the tables soon get a little monotonous, and the introduction is to be preferred. This gives an interesting account of the methods of computation and checking, and suggests methods of interpolation which could be used. A bibliography gives a list of earlier tables, most of which have been checked by the present calculators, and lists of the errors so found.

E. C. TITCHMARSH.

A NEGLECTED THINKER

The Philosophy of Peirce

Selected Writings. Edited by Dr. Justus Buchler. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi+386. (London: Kegan Paul and Co., Ltd., 1940.) 16*s*. 6*d*. net.

C. S. PEIRCE was a thinker of rare originality and depth, a logician brought up, as he said, in a laboratory. Nevertheless, though he influenced the development of mathematical logic in his lifetime, his general influence on contemporary thought has been almost entirely indirect, through friends, such as James, Royce and Dewey. His published writings, mostly short articles, have attracted little attention. The present reviewer has to confess that when he read a selection of these reprinted in 1923 under the title "Chance, Love and Logic" he failed to realize their value. Recently the great mass of manuscripts he left has been published, but few are likely to wade through the whole six volumes of his complete works. It is to be hoped, therefore, that this selection of published and unpublished work, with an excellent introduction by the editor, will make his work better known; for it is worth knowing in spite of its peculiar defects. Every now and again Peirce stated an important principle with force and clarity; but when he came to develop and explain it he tended to be pedantic and even confused and irrelevant. He had many of the faults as well as a good deal of the genius of Kant. He also suffered from being fifty years ahead of his time—he died in 1914 at the age of seventy-five. It must suffice here to mention three of his outstanding contributions to thought to be found in this book.

(1) It is often said that Peirce was the originator of Pragmatism; but his theory is not the same as James's. The starting point for Peirce was Alexander Bain's definition of belief as "that upon which a man is prepared to act". When this is applied to scientific belief it means that a theory prescribes certain operations to be performed and states the results that will follow the performance. If the results do not follow, the theory is false. If no kind of operation is prescribed by it, the theory cannot be shown to be false but is superfluous, and may be an obstacle to the formulation of the proper kind of theory. This attitude was novel in the nineteenth century though very generally accepted now. Peirce quite definitely avoided the fallacy of the Positivist or Phenomenalist view which leaves out the vital factor of "operations to be performed".

(2) Peirce was one of the first to realize that chance or randomness is a positive factor in the physical world, not merely a name for ignorance of causes, and that randomness on a microscopic scale is bound to lead to some kind of regularity on a macroscopic scale. Moreover, as he says, "those observations which are generally adduced in favour of mechanical causation simply prove that there is an element of regularity in Nature, and have no bearing whatever upon the question of whether such regularity is exact and universal or not. . . . Try to verify any law of Nature, and you will find that the more precise your observations, the more certain they will be to show irregular departures from the law. We are accustomed to ascribe these, and I do not say wrongly, to errors of observation; yet we cannot usually account for such errors in any antecedently probable way. Trace their causes back far enough and you will be forced to admit that they are always due to arbitrary determination, or chance" (p. 331). This was published in 1892. The general principle, of which Heisenberg's "Uncertainty Principle" is a special case, could scarcely be more definitely stated.

(3) The problem of the validity of inductive generalization has always been the logician's nightmare. Peirce goes to the root of the matter in a way that makes more recent writers on this subject look like mere fumblers. The first point he makes, generally accepted now but not in his own day, is that there is no complete certainty on matters of fact, only greater or less probability. Mathematical certainties are purely formal and would be the same if all facts were different. The second point which nobody else seems to have expressed properly is that the problem of inductive generalization is essentially one of sampling. The value of the information obtained from a sample as a guide to the character of the whole bulk of the material depends upon what we are looking for and how the sample is taken. If there is something in the bulk not revealed, however many samples are taken and by whatever method, then it is permanently latent and therefore negligible. If later samples reveal something that previous samples failed to reveal, the difference must lie in the method of sampling and is a genuine revelation of the character of the material. Where sampling takes the form of measurement, the calculus of errors provides a check on the value of the results, especially as to what improvement is to be expected by making further measurements by the same method. It shows that as a rule quite a small number of measurements properly made are very nearly as reliable as a very large number. Nothing like Mill's Principle of the Uniformity of Nature

is needed nor is it necessary to "postulate" anything. The only kind of *a priori* principle involved is like those put forward by Kant; namely, if anything is true universally of any aspect or part of experience it must be something involved in the conditions under which that experience is obtained. The questions to be asked are: What is known beforehand about the material to be sampled? By what method are the samples obtained and examined? From the answers to these questions we can assess the value of the generalizations in terms of probability. This explains why each inductive argument has to be considered individually on its merits and not in terms of general formal rules; why, though the notion of probability is involved, numerical values cannot be assigned; at the same time it makes clear that there is a common factor involved in all cases and the procedure is not merely irrational.

A. D. RITCHIE.

TELEVISION ENGINEERING

Principles of Television Engineering
By Donald G. Fink. Pp. xii+541. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 33*s*.

PRIOR to the War, Great Britain had established a very advanced position in the application of radio communication to television broadcasting. The inauguration by the British Broadcasting Corporation of the London television station at Alexandra Palace in August 1936 marked the beginning of the first public television service in the world. Much scientific research and technical development in this subject were being actively pursued in several other European countries, and more particularly by various commercial organizations in the United States of America. Since the outbreak of war, the public development and application of television to broadcasting has been brought to a standstill in Great Britain, whereas the technique of the subject has continued to be very actively pursued in America during the past eighteen months. There is good reason to believe, however, that when happier times return, Great Britain will be able to recover a place in the front line of television broadcasting. A good deal of the technical work now being carried out for war purposes by radio engineers and physicists will probably find ready application to television problems when peace comes; while the recent demonstration given by Mr. J. L. Baird of television in natural colours indicates that the small amount of experimental work still in progress is already producing fruitful results.

In preparation for the expansion of the radio industry in America from normal sound broadcasting to include the very wide field of television, Mr. D. G. Fink's book, entitled "Principles of Television Engineering", is probably very opportune. The author is the managing editor of the periodical, *Electronics*, which radio workers in Great Britain find so useful in giving them a survey of progress in the United States of the application of electronic devices to radio and other engineering problems.

The television engineer requires a knowledge both of the technique of radio communication at ultra high frequencies, and of the optical problems involved in analysing a picture or scene at the transmitter and rebuilding it at the receiver. Mr. Fink deals with the whole subject within this scope. The historical aspects of the television field are wisely ignored, and a knowledge of fundamental physics and of ordinary radio technique is assumed.

The early chapters of the book deal with the analysis and scanning of the picture, and the principles of the devices used to convert the variations in light intensity into electric impulses. Following chapters describe the nature of these impulses forming the video signal, which after amplification provides the modulation of the radio frequency carrier waves broadcast to the distant receivers. At the receiving end the process is reversed, and the modulation signals are extracted in order to provide the impulses necessary to reproduce the picture on the screen of the cathode ray tube in the receiver. All these subjects are dealt with in a clear and thorough manner, and references are given, mostly but not entirely, to American literature, which will enable the reader to delve deeper into any aspect of the subject in which he is particularly interested.

The last two chapters in the book deal with the practice of television broadcasting in the United States from studio to transmitter, and of the design and construction of receivers. These, together with the appendix, which sets out the nomenclature, standards, and recommended practices drawn up by the American Radio Manufacturers' Association, should make the whole work of considerable value to engineers responsible for the development and expansion of television throughout the world. The production of this volume is quite in accordance with the very high standard normally attained by the publishers.

Textile Testing

Physical, Chemical and Microscopical. By Prof. John H. Skinkle. Pp. x+272. (London: Macmillan and Co., Ltd., 1940.) 15*s*. net.

PROF. SKINKLE'S book will be welcomed by those engaged in the textile industry as well as by teachers of textile technology. The author has had an ambitious aim. He has endeavoured to cover the physical, chemical and microscopical aspects of textile testing. The microscopical section, which deals with the identification of fibres, might with advantage have been illustrated. The physical section describes all the usual physical tests and, indeed, includes several tests which might not normally be expected in a book of this kind. In the chemical section, the author indicates how fibres, both synthetic and natural, may be related in chemical nature to the carbohydrates and proteins respectively, and he has given standard American methods of analysis of synthetic and natural carbohydrate fibres, and of wool and silk.

While the book in many respects may be regarded as a students' working manual, in others it is more ambitious. It outlines, for example, current conceptions of cellulose, wool and silk structure, and it makes abundant reference to the *Journal of the Textile Institute*, in which much modern textile research is published. The book should certainly make a valuable addition to the textile libraries of Great Britain. It is a pity that the diagrams, as, for example, that of the Soxhlet extraction apparatus on p. 159, are frequently poorly reproduced. In any later edition, attention should be given to this point.

Plant Microtechnique

By Donald Alexander Johansen. (McGraw-Hill Publications in the Botanical Sciences.) Pp. xi+523. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 30*s*.

THE author points out that during the past ten years immense strides have been made in microscopical technique and in our knowledge of life-histories, and the present volume is an attempt to sift the mass of information in the literature and to correlate it so as to be of optimum service to laboratory workers. The book is not intended to be an encyclopædia of methods, but succeeds in giving in a readable form full details of a range of procedures which have been selected as the more reliable and generally useful, as the result of tests carried out in the Stanford laboratories. One of the marked features of modern methods is the tendency to use, wherever possible, whole-mount preparations, maceration and smear methods, and thicker in preference to thinner sections; and such points as these receive full attention. Adequate details are given for the making up of the stains recommended, and many useful hints are included as to the optimum thickness of section, time of day for collecting material for special purposes, etc., which may save much time in preliminary tests. Though the author deals to some extent with reagents of American origin, this is not likely to interfere appreciably with the value of the book to users in Great Britain.

The first section of the book gives a general survey of methods of fixation, staining, microtoming and of more specialized techniques used in cytology, whilst the second and larger section shows how these may be adapted as special methods for the various phyla. It is in dealing with Algæ, Fungi and such lower types, where the constructional substances may differ so widely, that the greatest difficulties are encountered in selecting suitable methods of preservation and examination, and it is probably on such points as these that the book will prove of the greatest value as a reference work, especially as the bibliography may also be used if further details are required.

For each phylum some details are given of the life-cycle, suggestions as to methods of collecting, preservation as herbarium specimens or for laboratory purposes, cultural methods and suitable stains. These details apply not only to the more elementary class types such as Spirogyra, Vaucheria, etc., but also so far as possible to such less-exploited types as the Pyrrophyta, Cyanophyta, Fungi Imperfecti, Lichens, etc. In the higher phyla details of staining, thickness of sections for embryo sacs of Gymnosperms and Angiosperms, methods for germinating pollen grains, etc., also include very numerous hints which should prove of the greatest value.

Industrial Solvents

By Ibert Mellan. Pp. xi+480. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 66*s*. net.

THIS is a mine of information; in it may be found the fungicidal action of diacetin, the intensity of the smell of isobutyl mercaptan, the solubility of nitrocellulose in ternary mixtures, and a vast amount of miscellaneous data which it would be exceedingly difficult to locate in the literature. Even in the book itself, the path is not always clear; a table of dielectric constants appears in the middle of a chapter on volatility and toxicity, while other tables and graphs having little or no connexion with the text crop up at intervals. The effect on the reader is the creation of a sense of bewilderment, particularly in the opening chapters, but this is dissipated by the major portion of the work, which is devoted to an excellent account of the properties of some 180 solvents arranged according to their chemical composition. Several pages are allotted to the more important substances and a few lines only to others, but it would seem that very little information has escaped the eye of the author, particularly when solutions of cellulose derivatives are concerned.

After a useful chapter on plasticizers, the book concludes somewhat unexpectedly with a section on graphical expression and interpretation which is so good that the intrusion may be forgiven.

Future editions would be improved by some rearrangement and a more detailed index, but even as it stands, the volume will be found indispensable to every user of solvents. H. E. W.

CYRENAICA: CULTURE AND ANTIQUITIES

ONCE more with the fall of Benghazi and the British occupation of Cyrenaica, the Libyan menace to Egypt is frustrated. For, indeed, the present campaign against the forces of Italy in her North African colonies is but the latest phase in a conflict between the peoples of the Valley of the Nile and the dwellers in the Libyan Desert and on the coastal fringe westward from Egypt, which *mutatis mutandis* has endured intermittently for many a hundred years. So long ago as the thirteenth century B.C., when the Nineteenth Dynasty ruled over Egypt, Pharaoh Menephthah drove back from the Delta the attack of the peoples of the Mediterranean Sea, Achæans and Lycians, Sardinians and Tyrsenians as they are thought to have been, who, in alliance with and under the leadership of Libyan chiefs, sought to overrun the rich lands of the Nile. But such acts of aggression were not entirely one-sided. Long before, under the Twelfth Dynasty, Amenemhat I had sought to extend his empire over Libyan tribes with the object of exacting tribute from the wealth acquired by their control of the caravan routes from the interior. Under the Twenty-second Dynasty the Libyans with Sheshonq, the Shishak of the Bible who besieged Jerusalem, as their first ruler, established a hold over Egypt which endured from 950 until 740 B.C.

That campaigning in Libya in those days was no less strenuous than it was found to be by the British Imperial troops is suggested by the story of the rise to power of Amasis in 572 B.C. His army, when sent on an expedition into Libya, was convinced that it was intended that they should all perish. They rebelled and raised Amasis to the supreme power, displacing Hophra, the ruling monarch.

Since the Italian occupation, the term 'Libya' has been applied to the two provinces of Tripolitania and Cyrenaica. In the latter, the eastern province of Cyrenaica, geographical conditions, which have been made in some measure generally familiar by recent events, have had a marked effect on the history and development of culture of the inhabitants. The dominant features are two great plateaux which rise steeply from a narrow coastal strip, and then slope down to the desert, which the more important, Jebel Akhdar, reaches at a distance of some eighty miles. Its heights are well watered with abundant springs and its good red soil grows good crops of barley, while the Arabo-Berber nomad or semi-nomad tribesmen find here pasture for their herds of cattle, sheep and camels.

Little less important in a cultural context is the Augila depression, which runs by a remarkable series of oases from the Gulf of Sidra, the ancient Syrtes, to the regions of the Upper Nile. It has served as a line of communication and path of cultural diffusion for countless ages; but in recent years its importance as a line of communication with the interior has declined with the opening of the Khartum Railway. Of the oases traversed, Kufra, a group of five at the head of the Libyan Desert, covering some 7,000 square miles, is the most important; it is best known, perhaps, on account of the Senussi sect of Moslems, founded in the nineteenth century, who had their headquarters here until in 1928 the Italians occupied the interior, driving them back to the oasis of Jaghbub then recently ceded from Egypt. Of special interest to archæologists is the "lost" oasis of Oueinat, reached by A. M. Hassanein Bey in 1923, where were discovered some remarkable series of rock paintings and drawings which have since been the subject of considerable study and speculation.

The modern indigenous population of Cyrenaica, since the Arab conquest of A.D. 641, is Arabo-Berber, an amalgam in which the Berber tongue has virtually disappeared along with the script which, as inscriptions show, had been evolved but now survives only among the Masked Tuareg of the western Sahara. Physically, the population belongs mainly to the North African type of the Mediterranean race. Indeed, among the theories of derivation of the North African Berber as found farther to the west, one would assign them to an origin in Libya. In their origins the people of Libya would appear basically to have been closely akin to the proto- or pre-dynastic Egyptians, if reliance is to be placed upon the scanty human skeletal remains which have been found and examined, notably at Mersa Matruh.

Archæological evidence may well be regarded as bearing out a close relation with Egypt in early times. Finds of palæoliths of Mousterian type similar to those of Egypt would seem to confirm this view. On the other hand, more intensive exploration and study, such as the Stone Age has received in French North Africa and has been given by Miss Caton-Thompson to the Stone Age cultures of Khargeh, may reveal links by which Libya will be joined in a North African palæolithic complex. In the meantime, for later ages from

mesolithic times onward, detailed study of the Oueinat pictographs has not only revealed evidence of a cultural, even possibly a racial, sequence, but also in conjunction with other evidence the possibility of a connexion with north-west Africa, going back to neolithic or even mesolithic times, and of a diffusion of culture from the upper regions of the Nile which must have traversed Libya by the desert-oasis route and cannot fail to have had its cultural effect on the way.

Up to the middle of the nineteenth century, knowledge of Cyrene and the Pentapolis was confined almost exclusively to literary sources. From Herodotus, we learned of its foundation by Battos, its first ruler, as a colony from Therae, in accordance with the behest of the Delphic oracle, after a misunderstanding of the instruction that it should stand "between the waters" had led to an abortive settlement on the island of Plataea in the Gulf of Bomba. This took place in the middle of the seventh century B.C. The city, which was then built on the high ground in the midst of springs, and appropriately and of right was dedicated to Phœbus Apollo, grew to be the greatest of Greek colonies, with Apollonia as its port, after it adopted a constitution framed by Demonax of Mantinea. This constitution divided the people into three tribes and determined the hostility between Greeks and Libyans, which had previously prevailed and which the intervention of Amasis for the Libyans had failed to compose.

The foundation of Cyrene was followed first by that of Barca, then of Hesperides-Berenice (Benghazi) and Arsinoe, with Apollonia making up the five cities of the Pentapolis. Derna (Darnis-Zarine) was a later Ptolemaic foundation. Cyrene, after a period of great prosperity due to commerce, in which at one time the city attained a population of 100,000, was the home of the Cyrenaic post-Socratic school of philosophy: it declined under the Ptolemies, to whom it had fallen as a result of its submission to Alexander in 331 B.C. Trade between Egypt and Carthage, upon which its prosperity had largely depended, was then diverted to the more direct route through Barca. Towards the close of the Ptolemaic rule, Apian gave Cyrenaica to Rome by his will and, with Crete, it was formed into a Roman province. It now had a large Jewish population, but disorders among them in both Barca and Cyrene under Hadrian brought about a complete eclipse in favour of Apollonia in A.D. 115–16. The two cities revived under Arab rule and for some time thrived on the trade between Alexandria and Qairwan, to fall with the remainder of the province into obscurity and disorder when the Ottoman Turks came into power.

In certain respects the fate of Cyrene and its decline under the Ptolemies and its later Roman masters was a piece of good fortune for posterity. Alone among archæological sites of Greek origin of any importance in Roman North Africa, it preserves its early form virtually untouched by Roman magnificence. The state of preservation of the *temenos*, or sacred enclosure, is unique. Here two baths only were introduced by the Romans. Nothing was known of the antiquities of Cyrene until it was visited in 1861 by two English officers on leave from Malta, R. Murdock Smith and E. A. Porcher, by whom the dedicatory temple of Apollo was identified and a number of antiquities retrieved which were afterwards sent to the British Museum. The next exploration of any note was by an American expedition, and was directed to the excavation of the Acropolis. This began in 1910 but ceased when Cyrenaica was taken over by the Italians in 1912. Since then, excavations have been carried out more or less systematically by the Italians, and with some enthusiasm since 1928, when the Fascist colonial policy in Africa had assumed more highly colourful aims in the revival of the glories of the Roman Empire. The archæological finds from the excavations at Cyrene are deposited in the Museum at Benghazi, with the exception of the Aphrodite Anadyomene, which is in Rome.

The original foundation of the acropolis of Cyrene stands on the western of two hills. In the valley between them and climbing the south-western slopes of the eastern hill lies the town. The acropolis is surrounded by a wall. Outside on the north is the sanctuary of Apollo, below the sacred fountain Kyra. This spring issues through a portico from a tunnel artificially enlarged. Its course upward can be followed for three to four hundred yards, the walls being freely inscribed by visitors. The sacred precinct presents a new feature in Roman Africa, in that the underlying Greek plan can be readily followed. In it are the temples of Artemis and Apollo, each with a large altar standing before it. That before the temple of Apollo is twenty-three yards long. A remarkable feature of the temple of Artemis is a Nymphæum, which possibly may have been used for purificatory rites. In the floor of the temple of Apollo treasure cists have been found. The original temple erected by Battos I was reconstructed under Augustus, and a further reconstruction was carried out under (possibly) Hadrian, but the original plan is still to be discerned. Subsidiary temples, a Greek theatre, and Roman baths are within the *temenos* walls, which are entered by Roman propylæa. Some twenty marble statues have been brought to light on this part of the site. Among the more remarkable finds from the eastern hill is a fine head of Zeus of Pheidian type, showing a trace

of gilding, to which a head of Poseidon forms a pendant.

A striking feature of the plan of the site is the Sacred Way, which lead from the sanctuary past the sacred fountain to the Agora. This latter is a colonnaded area of the conventional Roman type, with its capitol and official buildings. Here, however, are also survivals from the Greek period, the Heroon and the tomb of Battos.

To most of those, however, who have visited ancient Cyrene, the most impressive spectacle has been the vast array of tombs which line the Sacred Way along the road from Cyrene to Apollonia. They vary in size and dignity from the simple cist, with its slab cover, to the elaborate and stately façade which admits to one or more halls or chambers in which the burials lie in pits in the floor and in recesses. A few wall paintings survive, for the most part representing some form of funeral games. Participants, all in Greek dress, are both black and white in colour. Presumably, therefore, as under the constitution of Demonax in civic matters, so in ritual, Greeks and indigenes ignored the colour line.

RICKETS, CALCIUM AND CEREALS

THAT consumption of cereals may in certain circumstances lead to the appearance of rickets was first shown in 1920, when E. Mellanby[1] found that increasing the amount of them in the diet of young animals that were deficient in the antirachitic vitamin increased the intensity of rickets. Mellanby at first supposed that cereals increased the rate of growth of animals, and therefore increased the demand for the food factors necessary for the calcification of the bones and teeth. But his later experiments showed that cereals could be graded in their rachitogenic effect, oatmeal being very potent, and wholemeal wheat flour being more rachitogenic than white flour; yet the cereals with the largest amount of calcium and phosphorus, such as oatmeal and wholemeal flour, tended to cause the lowest retention of these elements in the bones and teeth. Mellanby supposed that these cereals contained an active rachitogenic substance, and this view was strengthened by his observation[2] that the effect could be destroyed by boiling the cereal with dilute hydrochloric acid. He further showed that the rachitogenic effect of cereals could be completely antagonized by adding sufficient vitamin D to the diet, and that it could be largely antagonized by adding calcium carbonate or phosphate.

In the course of her experiments on diet and the teeth, M. Mellanby[3] showed that germination of oats did not affect their anticalcifying action, but this action was greatly diminished if they were ground and allowed to stand for two days. She considered that the destruction might be due to enzyme changes or to the production of vitamin D. Templin and Steenbock[4], however, found that the disappearance of the rachitogenic action of maize, when it was germinated and autolysed, was accompanied by a change of its organic phosphorus to the inorganic form. Steenbock *et al.*[5] had previously suggested that inorganic phosphorus added to the diet might not be equivalent in physiological properties to the organic phosphorus in cereals; their experiments certainly demonstrate the fact that inequality of phosphorus intake is not the sole reason for the difference in calcifying action of the various cereals.

Steenbock's suggestion that the phosphorus compounds of cereals differ in their biological availability was followed up by Bruce and Callow[6]. Most cereals are rich in phosphorus, but 50–80 per cent is present in the form of phytin-phosphorus, phytin being the calcium-magnesium salt of phytic acid (inositolhexaphosphoric acid). Using rats on diets high in calcium and low in phosphorus and vitamin D, Bruce and Callow showed that the rachitogenic effect of cereals could be explained by the low availability of phytic acid phosphorus. This form of phosphorus was also shown to be comparatively unavailable to man (McCance and Widdowson[7]). Bruce and Callow further stated that when deficiency of calcium was the factor limiting calcification, there were grounds for believing that excess of phytic acid would interfere with the absorption of calcium; and Starkenstein[8] had shown that calcium phytate was insoluble or non-ionized. Mottram and Palmer[9] concluded that the rachitogenic action of cereals is not specific, but is due to their unbalanced calcium-phosphorus ratio. But the more extensive work of Lowe and Steenbock[10] had shown that not only the ratio of calcium to phosphorus, but also the proportion of the latter present in the phytin of cereal, determined its rachitogenic potency; they found that phytin phosphorus was partially available to the rat when the diet was low in calcium, but that the addition of calcium carbonate made it almost completely unavailable.

Mellanby, however, considered that these experiments on the relative availability of phosphorus in different compounds had little direct bearing on the positive rachitogenic action of cereals which he had described. He had found that, under his experimental conditions, the addition of inorganic phosphorus produced no improvement in calcification, and the dietary conditions in his experiments with puppies approached much more closely the conditions leading to rickets in children (which is not usually affected by adding inorganic phosphorus to the diet) than did the experiments of Bruce and Callow using rats on diets high in calcium and low in phosphorus. But their suggestion that phytic acid interfered with the absorption of calcium was directly relevant, and was followed up by Harrison and Mellanby[11]. These workers found that phytic acid and neutral sodium phytate were strongly rachitogenic when given with a non-rachitogenic diet; commercial phytin was slightly antirachitic. They concluded that "while our experiments do not support the view that the non-availability of phytic acid phosphorus has anything to do with the anti-calcifying action of cereals under physiological conditions, they do strongly suggest that this anticalcifying action of cereals is due to the action of phytic acid in rendering Ca unavailable". On this view, further amounts of calcium will be used for calcification only after all the phytic acid has been precipitated, and therefore, since wholemeal flour contains more phytic acid than white, it is necessary to add more calcium to the former.

The antirachitic action of phytin was noted by E. Mellanby[12] and later by Palmer and Mottram[13]. De Bruin and Bouman[14] had concluded that the phytin content was not the cause of the rachitogenic action of cereals, and Harris and Bunker[15] had found no direct relationship between the amount of phytin phosphorus in cereals and their rachitogenic potency. These apparent anomalies were answered by Harrison and Mellanby. They suggest, for example, that in the gut commercial phytin (which is rich in calcium) might lose some calcium, which is replaced by magnesium or other bases, and this liberated calcium then might be slightly antirachitic.

The recent work of Steenbock and his colleagues[16] has shown that the whole tale of the rachitogenic action of cereals has not yet been told. Rats were given a diet containing no cereals, normal calcium and low phosphorus. Some phytic acid phosphorus was available even without vitamin D, but much more when the vitamin was given. This effect was less marked with inorganic phosphorus, and in no case was the utilization of phytic acid phosphorus equal to that of inorganic phosphorus. In other experiments[17], it was found that when calcium phytate was added to a diet containing no cereals and low in calcium, its calcium was as readily available to the rat as the calcium of calcium carbonate. Vitamin D improved the utilization of both forms of calcium to the same extent.

Recently, the same workers[18] have found that the availability of the phytic acid phosphorus was affected by the calcium-phosphorus ratio of the diet. With an optimum intake of phosphorus and a ratio of 1, phytic acid phosphorus was almost as readily utilized as the inorganic form. An increase in the ratio was accompanied by a marked decrease in the availability of phytic acid phosphorus but not of inorganic phosphorus; the ratio is of no great importance when the phosphorus is present in the inorganic form. Day[19] has shown that citrates promote calcification when given with a cereal diet containing high calcium and low phosphorus, but not when given with a purified diet; they have no effect on calcification when the calcium-phosphorus ratio is normal or low, irrespective of whether cereals are added. The cereal can be replaced by phytin with similar results.

At a recent meeting of the Physiological Society (Cambridge, December 1940), Sir Edward Mellanby gave an account of his work on the rachitogenic effect of oats, and Dr. R. A. McCance and Miss E. M. Widdowson briefly mentioned some recent results that they have obtained. Further, Steenbock and his colleagues[17] have promised to give consideration in a forthcoming paper to Mellanby's view that phytic acid acts by making calcium unavailable.

It is obvious, therefore, that a final judgment upon the rachitogenic effect of cereals must be suspended. But there can be no doubt that the addition of calcium to white flour, and particularly to wholemeal flour, overcomes the rachitogenic action of these cereals.

There is one aspect of the addition of calcium to flour that seems to have received no attention. Kletzein[20] showed that adding 1 per cent of calcium carbonate to the diet of rats diminished the iron content of their tissues (except the spleen). He further concluded: "That the retention of copper is affected by calcium supplementation in a manner similar to that of iron is suggested by other unpublished data of ours. The association of deficiencies of other minor inorganic elements such as iodine, manganese, cobalt, zinc and boron with excessive supplementation is suggested". Independently, Tompsett[21] has shown that both iron and copper are absorbed more easily on a low calcium than on a high calcium diet. From Tompsett's figures, it seems that increasing the calcium in the diet about sixteen-fold decreases

the body iron about 35 per cent. A rough calculation based on the amounts contemplated by Moran and Drummond[22] suggests that the calcium intake of Orr's lowest income group may be nearly doubled by the addition of calcium to white flour. This is, of course, a very much lower increase than that used by Kletzein and Tompsett in their experiments. Certainly, this is no argument against adding calcium to the diet to combat the widespread deficiency of that element in our population; but merely correcting that fault perhaps makes it more important to combat also the deficiency of iron, which is possibly even more serious.

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A LIEBIG CENTENARY

IN the autumn of 1840, just over one hundred years ago, there was published in England and Germany Liebig's famous book on "Organic Chemistry in its Applications to Agriculture and Physiology", which was destined to exert a profound influence on agricultural science and practice. It formed part of a report which, in 1837, the author had undertaken to write on the state of organic chemistry for the Chemical Section of the British Association for the Advancement of Science, and the English edition was "edited from the manuscript of the author" by Lyon Playfair, who presumably also translated it. Part 1 of this book deals with "the chemical processes in the nutrition of vegetables", and the shorter Part 2 with "the chemical processes of fermentation, decay, and putrefaction".

In treating these subjects almost entirely from the chemical aspect, Liebig followed in the wake of Humphry Davy, whom he calls "the immortal author of the Agricultural Chemistry", for Davy had there written:

"If land be unproductive, and a system of ameliorating it is to be attempted, the sure method of attaining the object is by determining the cause of the sterility, which must necessarily depend upon some defect in the constitution of the soil, which may be easily discovered by chemical analysis."

Liebig adopted this view, but went further; in the preface to the third edition of his book (1847), he wrote:

"Now that the conditions which render the soil productive and capable of affording support to plants are ascertained, it cannot well be denied that from Chemistry alone further progress in Agriculture is to be expected."

There was 'nothing like leather' for these distinguished chemists, and for many decades thereafter agricultural instruction in universities was undertaken as a branch of chemistry. The exaggerated importance of chemistry to agriculture at that time is quite understandable, for the science of microbiology did not exist, the nature of plant diseases and pests was virtually unknown, and no systematic attempt had been made to apply physics to agriculture. It was also due to the lack of biological knowledge that Liebig attempted to explain the phenomena of fermentation and putrefaction in terms of pure, if rather nebulous, chemistry: "whenever the way seemed long, or his heart began to fail" he would invoke such metaphysical entities as "the vital principle", *vis inertiæ*, etc., thus attempting to explain the unknown in terms of a greater unknown. The two outstanding merits of Liebig's book were that it applied, in a manner more complete than Davy and von Thaer had done, the torch of science to the unilluminated mass of facts which empirical practice had accumulated through the ages, and it laid on solid foundations the principle and practice of restoring to the soil certain nutrient elements which had been removed by previous crops.

Liebig was the first to throw light on the nature and functions of soil humus. He did not get very far, but it is doubtful if modern chemists have got very much further. He recognized that the humus

of plant physiologists and of chemists is no single chemical individual: the soil humus he defined as "woody fibre in a state of decay". He refuted the widely prevailing view that plants draw sustenance from soil humus other than the carbon dioxide disengaged in its decay, but he held that this action proceeds only in presence of growing plants, so that bare fallowing does not deprive a soil of humus; and that crop cultivation does not deplete the soil of humus, because this is regenerated by the organic substances excreted by plants through their roots. He laid much stress on these excretions or excrements, though he could adduce very little, if any, evidence of their existence.

According to Liebig, soil exhaustion is entirely a matter of depletion of mineral salts, chiefly those of the alkali and alkaline-earth metals, and fertility can be restored only by manuring, for example, with mineral fertilizers. He set the fashion in undertaking innumerable analyses of plant ashes, and he seemed to believe that practically every element found in the ash of a plant was necessary to its existence. Hence he devised a number of special manures containing a variety of mineral salts, some of which, such as potassium silicate and common salt, must have been redundant. These manures were a failure; farmers would have none of them. Though it is easy to criticize Liebig in the light of modern knowledge, one cannot help remarking on his failure to appreciate the nutrient reserves which nearly all soils contain in varying amounts, the availability of the added nutrients when incorporated in the soil, and the percentage recovery of them in the crop.

Foremost among Liebig's achievements in this direction was his recognition of the value of phosphatic and potassic manuring. He is usually, and probably correctly, regarded as the discoverer of the value of 'super' (superphosphate of lime) in the form of dissolved bones, for the preparation of which he gives a recipe in his book. It is true that Escher had already suggested the idea in 1835, and that during 1837–39 Lawes had performed many pot experiments with spent animal charcoal that had been treated with sulphuric acid (although there is apparently no written record of this work), but the idea could not have fructified without the work of Liebig. On the other hand, to Lawes must be ascribed priority in the preparation of superphosphate by treating mineral phosphates with sulphuric acid.

To the student of agriculture, Liebig is probably best known from his long-continued controversy with Lawes and Gilbert concerning how plants obtain their nitrogen. In the first edition of his book, Liebig wrote: "Cultivated plants receive the same quantity of nitrogen from atmosphere as trees, shrubs, and other wild plants; *but this is not sufficient for the purposes of agriculture*". In the fourth edition he altered the latter portion of the sentence to "*and this is quite sufficient for the purposes of agriculture*" (the italics are the writer's). Elsewhere, in both editions, he states that decaying nitrogenous organic matter contributes in a minor degree to the nitrogen supply of plants. Thus he shifted his ground; but his main contention was that atmospheric ammonia, originating in the decay of vegetable and animal substances, was the prime source of the nitrogen supply of plants. He was at some pains to explain how the ammonia (the amount of which in the air and rain water he over-estimated) became fixed in the soil, as both it and ammonium carbonate readily volatilize. He therefore postulated that minerals containing alumina, that is, clays, and iron have a great attraction for ammonia, readily combining with it and fixing it. He also asserted that humus and added charcoal act similarly. Lawes and Gilbert, in their classical experiments at Rothamsted, proved that the main source of the supply of nitrogen to plants was nitrogenous substances naturally present in, or added to, the soil. There was, of course, at that time no knowledge of nitrogen-fixing bacteria, either 'nodule' or free-living. The result of the controversy, besides settling the main point at issue, provided the scientific basis for nitrogenous manuring.

Great as were Liebig's achievements in wedding science to practice and in establishing the value of mineral manuring, it is open to question whether his chief title to fame does not rest upon his purely chemical discoveries; in any event his combustion-tube and potash-bulbs bid fair to attain immortality. One cannot agree with the dictum of A. W. Hofmann, in his Faraday Lecture to the Chemical Society in 1875, that he and Faraday were "stars of co-equal lustre", but one can stand in admiration of his intellectual ability, of his great success in establishing the first really educational laboratory at Giessen, which attracted students from many parts of the world, and of his striking personality. As a man of science, he was at times "rash in his speculations, hasty in his conclusions, and bitter in his controversies" (Odling), but in the social sphere he seems to have possessed all the virtues. Much of his success was probably due to his personality: he possessed the deep convictions and inner fire of a *Führer*, not one of the ultra-nationalistic type, but one who, at least in scientific matters, was a cosmopolitan at heart. At the same time he would doubtless have been ready to subscribe to the dictum of Pasteur, "*La science n'a pas de patrie, mais les savants en ont une*".

E. H. T.

OBITUARIES

Dr. Alfred Young, F.R.S.

ALFRED YOUNG, the fifth son of Edward Young of Birchfield, Farnworth, a prosperous Liverpool merchant of his time, was born in 1873 and died on December 19, 1940. His death is a loss not only to the parish of Birdbrook, where he was rector, and to many friends, but also to the wider scientific world in which as a pure mathematician he had won a distinguished place.

Educated at Monckton Combe School, Young gained a scholarship in mathematics at Clare College, Cambridge, which he entered in 1892. It was there that I first met him and began a friendship which continued throughout his life. As an undergraduate he took part quietly in the ordinary social and athletic life of the College. A pupil of the celebrated mathematical coach Webb, of St. John's College, he took his B.A. degree in 1895, being bracketed 10th wrangler in a year which included the names of Bromwich, Grace, Whittaker, Hopkinson and Godfrey. It was early in his third year that his interest in research began; his enthusiasm for it diverted him from the subjects laid down for the Tripos examination. His place in the lists would almost certainly have been higher if he had confined his energies to the schedules; undoubtedly, however, he chose the better path.

Young had always intended to take Holy Orders, but it was not until 1908 that he was ordained. In the meantime, he continued his mathematical research; he was the author of many papers in the scientific journals, and collaborated with Grace in "The Algebra of Invariants" published by the Cambridge University Press—the standard work on the subject. For some years he lectured at Selwyn College, but resigned that appointment shortly after his election to a fellowship at Clare in 1904. His work received recognition when in 1908 he was accepted for the degree of Sc.D. at Cambridge, in 1931 when he became honorary LL.D. of St. Andrews, and further in 1934 when he was elected a fellow of the Royal Society. This latter honour he shared with his elder brother Sydney Young, professor of mathematics at Trinity College, Dublin. Prof. H. W. Turnbull tells me that "as Young developed his method of Quantitative Substitutional Analysis he was led to the study of the Theory of Finite Groups of which Burnside and Frobenius were the leading exponents. In Group Theory Young was a worthy successor to Burnside; as an algebraist he stood in the front line, and in sheer algebraical manipulation he possessed an insight which can only be described as uncanny".

Young served after his ordination for two years as a curate of Christchurch, Blacklands, and was then presented by his College to the rectory of Birdbrook. His good work as a parish priest led to his appointment in 1923 to the rural deanery of Belchamp and to an honorary canonry at Chelmsford shortly before his death. He was an excellent preacher; a sermon of his at the Commemoration of Benefactors at Clare stood out among many such discourses to which I have listened, as admirable both in substance and in style.

Young had a quiet humour. I remember an occasion when he said to me with a grave face: "I have lost all sense of personal security". It appeared that the maidservant at his Cambridge lodgings had used some of his manuscripts to light the fire rather than waste clean paper for that purpose.

He was married in 1907 to Edith, daughter of Edward Wilson of Eccleshall, by whom he is survived. There were no children of the marriage.

G. H. A. WILSON.

Dr. G. E. Vincent

THE last public appearance in London of Dr. George Edgar Vincent, president of the Rockefeller Foundation from 1917 until 1929, who died in New York on February 1, was at a luncheon given to him at the Criterion Restaurant on May 18, 1932, by the English-Speaking Union. He was a tall bronzed man of sturdy figure, expressive in countenance and eager-eyed. Talking upon the broad subject of international philanthropy in international relations, Vincent revealed himself as an amiable and persuasive character, more French than Anglo-Saxon in the rapidity and preciseness of his thoughts, as if he feared he would have not quite time enough to say all he wanted to say. It was clear to his audience that here was a man who in his day had convinced many listeners, both individual and collective.

Vincent was born in Illinois, but like many middle-westerners of the abler sort, was educated at Yale. Returning to Chicago, he taught sociology in its university. In the long vacations he joined the Chantanqua Institution, which gave lectures upon literary and scientific subjects, lectures held in tents, in many parts of the country. This varied experience with students well fitted Vincent to become Dean at Chicago (1907), then president of the neighbouring University of Minnesota (1911). His first connexion with charitable trusts was three years later; he joined the General Education Board, endowed not long before to assist American universities.

But at Minnesota, where he continued, Vincent put a strong hand to the expansion of its post-graduate schools of law, medicine, chemistry, engineering, and agriculture. Minnesota is one of the richest of American western universities, which draws large income from copper mines owned near Lake Superior, and Vincent, with such backing, found his opportunity. Meanwhile, so impressive was the counsel which he was offering to the General Education Board, that in the midst of the last war, in 1917, he was invited to the presidency of the Rockefeller Foundation.

Vincent had long been distressed over the meagreness of academic salaries. Many abler young graduates

avoided teaching for more lucrative careers. He therefore strongly advocated, as soon as the War of 1914–18 ended, a distribution of £2,000,000 to endow and increase salaries of American university staff. This was the scheme under which the Rockefellers added a dollar to every dollar raised for that purpose by any well-established university or college. In the end 170 of them participated.

At this period the Foundation, under Vincent's leadership, was making large benefactions to medical education. It was particularly interested in China. Vincent, after leaving Yale, had travelled in the Orient, and his advice in respect of the support of Peiping Union Medical College was invaluable. Again, a signal gift under his regime was £500,000 for the London School of Hygiene and Tropical Medicine.

Vincent's final activities up to his retirement in 1929 included organizing for the Rockefellers the division of social sciences, in which he was a specialist, and the divisions of natural sciences and international health. WILLARD CONNELY.

Prof. B. P. Haigh, M.B.E.

BERNARD PARKER HAIGH, professor of applied mechanics in the Royal Naval College, Greenwich, who died on January 18, was born in 1884. Educated at Allan Glen's School, Glasgow, and afterwards at the University, he was apprenticed to Bruce Peeples, electrical engineers in Edinburgh, where he worked under J. L. la Cour, the inventor of the rotary converter which bears his name. This association took Haigh to Germany and to Sweden, where he obtained much valuable experience. From 1909 he was engaged for two years on the design of steering gears at the Edinburgh firm of Brown Bros., and then became assistant to Prof. Archibald Barr at the University of Glasgow. It was in 1913 that Haigh took the step which was to determine his career, when he became lecturer in applied mechanics at the Royal Naval College, where he succeeded in 1920 to the chair left vacant when Sir James Henderson retired in order to give his whole time to gunnery problems.

At Greenwich, Haigh found himself immediately confronted with a variety of new problems connected with the Royal Navy. He became a scientific adviser to the Paravane Department of the Admiralty. Of his successful work in this connexion, the solution of the problem of lengthening the life of the steel ropes which towed the paravanes in their duty of cutting the moorings of mines may be mentioned. Haigh considered that the very short life of these ropes was due to fatigue caused by resonance brought about by synchronization between the natural periods of vibration of the rope under tension and the eddies thrown off by the rope as it passed through the water. He deduced a formula and was able to increase considerably the life of the ropes. During this investigation Haigh realized, about 1917, that fatigue was greatly accelerated in steels when it takes place in the presence of a chemical reagent. He likewise established that corrosion prior to fatigue has but little effect on the fatigue limit. These were new discoveries of fundamental importance. The phenomena were rediscovered some ten years later by McAdam and are now popularly known as 'corrosion fatigue', a terminology of which Haigh strongly disapproved on account of the second fact mentioned above. These discoveries accentuated the interest which Haigh had taken, from his student days, in fatigue of metals, and on this matter he became a recognized authority both here and abroad. A large part of Haigh's published work is directly inspired by ideas connected with fatigue, although he wrote many papers on plasticity, welding, fracture and allied topics. He was also the inventor of the Haigh fatigue testing machines which are internationally used in experimental laboratories. Much of his work was of a confidential nature, and he was always busy with some Admiralty problem.

Apart from this Haigh was a very active participator in general scientific affairs. He attended the International Congresses for Applied Mechanics and was present at the recent World Power Congress in America. He was also a member of the British Association Committee on Stress Distribution in Engineering Materials and read several papers before the Association.

At the beginning of the present War, Haigh was selected as scientific adviser to the Engineering Research Laboratory of the Admiralty. At the funeral service in the Chapel of the Royal Naval College, the Chaplain of the Fleet in his encomium stated that Haigh had suggested and helped to perfect the method of overcoming the magnetic mine.

To appreciate Haigh's enormous energy it must be remembered that these activities were in addition to his teaching duties. In teaching as elsewhere Haigh was eminently successful, for he had an unrivalled gift of communicating his own enthusiasm for his subject and a quite uncommon knack of choosing happy and apt phraseology. His loss will therefore be felt by the many Naval officers who have been instructed by him, as well as by his colleagues at the Royal Naval College, who found in him loyalty and friendship.

Haigh married, in 1915, Mildred Cole. They have one son, Ian, who is now on the staff of Sir Alexander Gibb. L. M. MILNE-THOMSON.

Mr. H. W. Macrosty, O.B.E.

MR. H. W. MACROSTY, president of the Royal Statistical Society, died at his home at Woking on January 19. Mr. Macrosty had been an honorary secretary of the Society for twelve years prior to his election as president in June last. His interest in statistics was derived from his official duties in the Board of Trade, where he was prominently associated with the work on the national census of production from its inception in 1907. His work was essentially that of providing data for economists and statisticians and in providing critical comment on those data. This did not bring him into the limelight which is shed upon those who announce policies or enunciate economic propositions, but as a contribution to national service such work is in no way less important

than that of those who come more prominently to public attention. Only those statisticians with practical contact with industry and trade can properly appreciate the true value of the work of those who produce statistical data.

It was the great merit of Macrosty and his co-workers at the Board of Trade that they concentrated upon accuracy and reliability in the statistical material they collected and which was the basis for the measurement of the industrial production of Great Britain. To the uninitiated a statistical table looks much the same whether drawn up from slipshod material or from data thoroughly sifted and scrutinized. The scrutiny and criticism by the Census of Production Office of the virgin material has been of the greatest importance. As a consequence, it can be truly said that although the volume of official statistical output relating to industry in Great Britain has lagged behind that of a number of others, its quality is such as to afford confidence to those who turn to the various reports for guidance and instruction, and Macrosty played a great part in establishing the confidence felt in the reliability of British official data relating to trade and industry.

To the Royal Statistical Society Macrosty gave unsparingly, both in the capacity of senior honorary secretary for many years and by practical contributions to its *Journal*, while he was the compiler of the attractive volume recording the history of the Society through a hundred years and published at the celebration of its centenary in 1934.

Mr. Eliot Howard

WITH the death of Eliot Howard on December 26 a distinguished ornithologist has passed away.

Howard was one of the notable amateurs for which British science, and especially perhaps British natural history, has always been distinguished. His professional work was with the firm of Stewart and Lloyd, of which he was a director for a number of years. In spite of this, he kept up his interest in field ornithology and published several important books on the subject. His most extensive work was a monograph on the British warblers (1907–1914), which embodied a great number of new observations made by himself on their habits. These observations, together with others on other types of birds, were generalized in his "Territory in Bird Life" (1920).

Though Howard was not actually the originator of the idea of territory and its importance in the life of birds, it was through his work that its importance became generally realized. He published three later studies, including "An Introduction to the Study of Bird Behaviour" (1929) and "The Nature of a Bird's World" (1935), in which his increasing preoccupation with the philosophical bearing of his observations became evident. Many of his friends perhaps regretted this preoccupation, as in their view it interfered with his publishing the vast body of original observations which he had accumulated on many species of birds. However, ornithologists will be glad to learn that his notes have been left by his widow to the Edward Grey Institute of Field Ornithology at Oxford, where they will be available for students. The Institute now possesses the field notes of all the major British field ornithologists of the last generation—Selous, Coward, Jourdain and Howard.

Howard was an outstanding example of how an amateur worker could achieve results of first-class scientific importance through patience and immense attention to accuracy and personal observation. His death is a great loss to ornithology.

Dr. W. C. Bosanquet

DR. WILLIAM CECIL BOSANQUET, a distinguished London physician and classical scholar, died on January 24 at the age of seventy-four. He was educated at Eton where he was a King's scholar, at Oxford where he gained a first class in Classical Moderations and Lit.Hum. and was elected a fellow of New College, and at Charing Cross Hospital. He qualified B.M. and D.M.(Oxon.) in 1897, and seven years later was elected a fellow of the Royal College of Physicians, before which he delivered the Goulstonian Lecture in 1905, his subject being "The Nature and Treatment of Diabetes Mellitus". He was physician to Charing Cross Hospital, the Brompton Hospital for Consumption, the Victoria Hospital for Children, and the Lock Hospital. During the War of 1914–18, in which he was Captain and Major in the R.A.M.C., he served as consulting physician in the North Western Frontier Force, India. His literary activity, both as editor and author, was considerable. Besides being editor of the *Practitioner* for some years, he was assistant editor of the third edition of "Quain's Dictionary of Medicine" (1902) and editor of the eleventh (1911) to thirteenth (1923) editions of Green's "Manual of Pathology and Morbid Anatomy". In addition to numerous articles in the *Lancet* and *British Medical Journal*, he was the author of "Serums, Vaccines and Toxins" (1904), in the second and third editions of which Dr. J. W. H. Eyre was his collaborator, "The Stomach, Intestines and Pancreas" with Mr. H. S. Clogg, his surgical colleague at Charing Cross Hospital (1909), and "Spirochætes: A Review of Recent Work with Some Original Observations" (1911). In his last work, written in retirement three years before his death, entitled "Meditatio Medici: a Doctor's Philosophy of Life", he discussed the ancient and modern views of the material universe, the development of man, the physical aspects of consciousness or mind and the principles of voluntary action or conduct.

J. D. ROLLESTON.

WE regret to announce the following deaths:

Eugen Dubois, discoverer of *Pithecanthropus erectus*, on December 16.

Prof. G. Dawes Hicks, F.B.A., emeritus professor of philosophy in University College, London, on February 16, aged seventy-eight.

Dr. A. T. Masterman, F.R.S., formerly superintendent inspector, H.M. Board of Agriculture and Fisheries, on February 10.

NEWS AND VIEWS

University of Birmingham: Annual Report

THE annual report for the session 1939–40 of the vice-chancellor of the University of Birmingham, Dr. Raymond Priestley, contains many points of interest. Two developments of major importance are the institution of family allowances for members of the staff and the introduction of compulsory physical training. Dr. Priestley, believing that the general tendency of social reform is towards the acceptance of the family rather than the individual as the normal financial unit, has long been a convinced advocate of the principle of family allowances, and he considers that universities should lead rather than follow in such matters, once they are convinced that it is right to move. He "does not fear that the introduction of family allowances will substantially delay or permanently affect the overdue improvement in the salary scales of the middle ranks of the University hierarchy where the shoe admittedly pinches most". The system is not ideal, because it cannot take account of dependants other than children, but there appears no way of overcoming this drawback without introducing unworkable complications and opening loop-holes which might be unreasonably exploited. Critics lay stress on the principle of equation of reward to quality of service, and so does Dr. Priestley, but he would measure reward in terms of standard of living rather than in money, and he would not have men penalized for having families. The allowance (confined to members of staff whose salary does not exceed £700 per annum) is at the rate of £25 per annum for every child, undergoing full-time education, up to the age of eighteen years. The allowance for the wage-earning staff is 2*s*. 6*d*. per week for each child up to the age of sixteen years if undergoing full-time education. The scheme has been in operation since February last year.

The second development is compulsory physical training for first-year students of both sexes. Two periods of ½-hour each week are devoted to this, and the work is regarded as an integral part of the degree course, reasonably regular attendance being required. Classes of exception and individual exemptions are provided for, but the great majority of students are covered by the scheme, which is supplemented by voluntary classes in the later years. It was intended that there should be a compulsory medical examination of all students entering the University; but this is at present impossible owing to war-time demands on the local medical personnel. There is a military option in the form of membership of the Senior Training Corps. Dr. Priestley thinks this measure of compulsion is right and reasonable as a means of securing the fullest development of the student. In the conviction that the University is concerned with the development in its students of a sense of social responsibility, and of character, membership of the Guild of Undergraduates was long ago made compulsory. The universities are supposed to be training the leaders of the future. They will produce better results if they can improve the physique of the students for whom they have to cater.

Warm appreciation is expressed of the foundation by Mr. Charles Brotherton of the Charles Brotherton Trust to benefit six industrial centres, of which Birmingham is one. This University has benefited immediately by the foundation of two post-graduate scholarships (each of £150 a year) in chemistry. The terms of these scholarships include provision for the candidature of graduates of other universities. "The scholarships are therefore a valuable supplement to the still too few aids to circulation of graduates between universities, an objective that should, I believe, be kept in the forefront of any university graduate scholarship and Fellowship policy, but which is too often hampered by the local patriotism of donor and of university." The University buildings have suffered considerably from enemy action, and the damage would have been much greater but for the energetic action of the A.R.P. workers. It is surprising to learn that the extra-mural work of the University has been maintained and even extended.

Pharmaceutical Students and Military Service

WITH reference to the note on the application of the National Service (Armed Forces) Act to six new groups, covering the ages of 18–19 and 37–40, which appeared in NATURE of February 8 (p. 172), it appears that the question of the reservation of medical and dental students irrespective of the stage they may have reached in their studies has been made more comprehensive by the inclusion of students of pharmacy. It is understood that the Pharmaceutical Society is making representations to the appropriate Ministry concerning the future supply of pharmaceutical students. Such students are at present reserved from military service when they have completed two years of training, and the terms are so worded that they prevent newcomers into the pharmaceutical calling from securing reservation before they are qualified. The consequence may be that after the present generation of students has passed their examinations, there may be only women entrants to the profession for the duration of the War. It is hoped to secure a modification of the schedule which will facilitate the maintenance of a reasonable annual intake of students.

The British Museum in War-time

THE removal of the exhibits and the closure of the galleries of the British Museum (Bloomsbury) as a necessary precaution against the hazards of aerial attacks as well as a depleted staff have by no means been allowed to impose complete cessation of all activities connected with the national collections normally housed here. Indeed, even as a place of

public interest and resort, the small exhibition of antiquities in the Prehistoric Room reopened in August last and the selection of books, manuscripts, prints and drawings in two ground-floor rooms have proved a considerable attraction for visitors from overseas and others. The exhibition in the Prehistoric Room includes models of prehistoric sites in Britain and a number of small archæological exhibits and photographs, an evolutionary series of European prehistoric tools and weapons of stone and bronze, a series of newly designed labels giving an outline of European prehistory or early history from 550,000 B.C. to the Norman conquest, a small case of Romano-British antiquities, and photographs and other illustrations of the Saxon ship-burial at Sutton Hoo. The exhibits are either duplicates or of little intrinsic value.

Members of the public and archæologists in particular will, however, receive with regret the announcement that one branch of the Museum's work hitherto carried on without modification or interruption will now cease, at least for the time being. The current number of the *British Museum Quarterly* (14, 4; 1940) contains an announcement that publication must now cease until after the War. The excellence of the illustrations and the scholarly character of the contributions, especially when they turned aside from description to broader issues raised by the exhibits, have won for this periodical an enduring place in the literature of the studies with which the Museum is concerned.

Rationalists and Current Concepts

THE RATIONALIST ANNUAL for 1941 (London: The Rationalist Press Association, 1940, pp. 86, 1*s.* net) includes, as usual, a number of articles which are calculated to stimulate controversy, even though some of them may appear to have been written with a sub-intention *pour épater le bourgeois*. Dr. Gilbert Murray in "Why Despair of Reason?" discusses the thesis that the modern psychologists, in diminishing the authority of reason, have played an important part in turning "a decent and humane world into an ill-managed lunatic asylum"; while Sir Peter Chalmers Mitchell in "Religion in Trouble", in citing the Union of Soviet Republics as an example of the inefficacy of prayer, expresses profound admiration for the achievement of that "new force of civilization" in education and public health. From the former as a "capacity-catcher" he looks forward to "an almost colossal contribution to the progress of mankind". In a contribution on the laws of Nature, Prof. J. B. S. Haldane expounds the modern concept of their nature and authority, noting in particular such modification as has been introduced by the recent work of Jeffreys and Milne, summing up in the conclusion that "so far from being laid down by the arbitrary word of a creator, they [natural laws] may prove to be a system as intimately and rationally knit together as the propositions of geometry, and yet changing and evolving with time like the forms of plants and animals."

Of special topical interest is the article by Sir Arthur Keith on "Human Nature: a New Approach to its Study", in which he returns, but from rather a new point of view, to his now familiar argument of the part played by war in the evolutionary development of races and nations. Briefly, his argument here is that the hormones, being responsible for the differential development of racial (physical) characters, the reaction against contact and interference from outside which is characteristic of the group from the most primitive social stage onward, and is the motive force which lies at the root of the impulse to war, is a provision in human nature to preserve the integrity and isolation of the group as a breeding ground for the development of group or racial characters. Man's mental constitution, therefore, in Sir Arthur's view, thus becomes the 'breeder' responsible for race-building. Passing over the question whether he has not here allowed his metaphor from selective breeding to betray him into a false personification of man's mental constitution, it seems illogical that while he admits the continuous development in size and complexity of the social group within which inter-group discords and enmities are eliminated, he turns away from the conception of one single group embracing all mankind throughout which there would be no more war. Is it not possible to ask whether, if *Homo sapiens* is one single species, is the group struggle to perpetuate racial differences necessary to his survival?

Carnegie Corporation of New York

THE report of the Carnegie Corporation of New York for September 30, 1940, includes the reports of the president and of the treasurer on the Main Endowment Fund and on the British Dominions and Colonies Fund. The report of the president, Mr. F. P. Keppel, points out that the Corporation has for the first time in many years incurred obligations in excess of the current income of the main endowment fund; this is due mainly to the voting of an emergency fund of 750,000 dollars for the Carnegie Institution of Washington, in addition to a grant of 150,000 dollars to make it possible for the Institution to construct a cyclotron, and to a grant of 650,000 dollars for Harvard University for the reorganization of the Dental School, but partly to the continued low interest rate. Other grants made during the year have been in the field of adult education, library interests, the arts, research and publications. Mr. Keppel points out that as yet there has been no appreciable reduction in the total supply of funds available from all sources for education and research in the United States. Steadily increasing opportunities for fundamental research are being provided by commerce and industry; funds from Federal, State and municipal sources are being maintained and probably increased.

Despite the new and compelling calls for emergency relief in the United States and abroad, a strong appeal for a good educational or social purpose has proved effective with individual donors. Mr. Keppel, however, welcomes the growing evidence of what may be termed a conservation

movement in cultural philanthropy shown in the co-operative groupings of institutions which hitherto have been competitive. These groupings, which are found all over the United States, are both formal and informal, including both tax-supported and independent institutions, and they are beginning to demonstrate that steps of this character will not only save money, but also definitely improve the service rendered to students and others. The Carnegie Corporation was specifically chartered for the advancement and diffusion of knowledge and understanding. These are the broad purposes of any non-specialized American foundation. Through consultation with experts, as fair a picture as possible is obtained of each proposed inquiry, and of the human qualities of the inquirer or inquirers. The selection of those to be supported is left to the lay judgment of the Board, the decision to be made in terms not only of comparative promise but also of the funds which the Foundation itself may have available and the chances of support from other sources.

Education, the second major channel of productive activity, requires public approval and public understanding. Mr. Keppel considers that the prospect of increasing public interest in this is favourable. Much, however, remains to be done to clear the public mind as to what the public itself requires from education, and what it can reasonably expect, and also to clarify teachers' ideas as to what the processes of formal education can and can not do to affect the social order. Mr. Keppel emphasizes the importance of recognizing the enormous range in the native abilities of different individuals, as well as the failure to make the fullest use of the great body of professionally trained men and women. We must also grasp much more clearly the underlying unity of the educational process as a whole, beginning for each human being with birth and ending only with death. Division of education horizontally into its various stages, and vertically according to subject of study, has its utility, but parallels of latitude and meridians of longitude do not exist on the face of Nature. The present world situation is regarded as a further challenge to the Foundation to justify its place as a social instrument enjoying exemption from taxation and other valuable privileges.

World Affairs

RECENT Oxford Pamphlets on World Affairs (London: Oxford University Press. 3*d*. net each) well maintain the standard of the earlier numbers of the series. Mr. R. W. B. Clarke, writing on "Britain's Blockade", stresses the need for a dynamic strategy. He reviews the position of specific classes of raw materials, the crucial example of which is oil, as well as the problem of the time-factor and finally the question of food supplies, both in the enemy countries and in the occupied territories. He considers that from the summer of 1941 onwards, open weaknesses may begin to develop. Prof. H. A. R. Gibb's pamphlet on "The Arabs" describes the effect of the impact of the West upon the Arab world, from Arabia to Morocco, and the re-awakening of Arab self-consciousness and nationalism. It provides a valuable background in following the campaign in the Western desert, and indicates some of the problems which confront statesmanship when General Wavell's campaign has been successfully concluded. In Pamphlet No. 41, Mr. E. L. Woodward, under the title "The Origins of the War", seeks the deeper causes of the War. These he finds in the hostilities of certain dominant tendencies in German thought to the liberal, humanitarian philosophy and way of life of Western civilization. National Socialism, he insists, "inherited an evil tradition, and unless this tradition is understood it is impossible to realize the deeper causes making for war in Germany. We are fighting for a particular way of life, which already through the sacrifice and energy of past generations has brought us out of barbarism and set us towards a reasonable and humane existence. As long as our opponents accept their Dervish-like submission to an opposite way of life, our good is their evil and their evil our good".

Occupational Guidance

THE United States Department of Education has published a bulletin entitled "Occupational Information and Guidance: Organization and Guidance" by three experts (Washington, D.C. 25 cents). It is heavily written but important, as it begins a guidance series with a "comprehensive and basic statement of its specific functions". It gives the policy of the Office of Education with the Federal assistance which can now be claimed, the scheme as it is working at present, and types of programmes from several States. The movement is fairly new, as it began in Boston in 1909, and has penetrated far enough of late years to be called "national". The technical vocabulary employed is tedious and we select a simpler statement of the idea behind the efforts made. There are, and can be, no "misfit" children. "The child is what education is for. One might as well say that a man does not fit his clothes as to say that the child does not fit the school."

This doctrine demands a very wide appreciation of ways of making a living, and we are glad to see that this freedom is recognized. Modern conditions of competition have led to extensive changes. Retardation in education and "labor turn-over in industry" were discovered about the same time. To-day the secondary school hands over less desirable pupils to the vocational, and such schools increase, while attendance at continuation lessens. The most earnest of educators can be misled by lack of insight, or late development among young people. Napoleon left the school of Brienne for Paris carrying the recommendation that he might possibly become a fair officer of marines, but nothing more. Anthony Trollope, that best of entertainers in later life, was a dull young man. There is another danger about this vocational enthusiasm, that buying and selling and making a good living out of the process may be regarded as the one aim of living. Some years ago a publicist in Great Britain was able to tell a convention

that "Business is the highest form of citizenship and advertising is the highest form of business". Does that view make for happiness, when a man is tired of his job, or for the altruism of good citizenship? A superintendent of schools in the largest American city writes of showing a pupil how to be a radio announcer, or a baseball player. What will he do when the voice is gone, or the muscles for hard hitting are relaxed? There are many new jobs to-day, but one old one remains—the use of leisure time.

Education in the United States

EDUCATION has the name of being a dull, dismal subject, though it is incessantly concerned with youth, which is in the fine phrase of Pericles the spring of the world. Its exponents are full of its jargon and have not reached the last triumph of writing, which is simplicity. American work is usually too widely documented to be bright. So we welcome as an exception to this heaviness the October numbers of *School Life*, which comes from the U.S. Office of Education (monthly except August and September, 1 dollar a year), and *School and Society*, which is run by the Society for the Advancement of Education (15 cents a copy). Both have a direct touch with the busy world scarcely possible in Great Britain, where there is less interest in vocational education; in the United States it leads to leaflets on poultry as well as on Soviet ideas of instruction. *School Life* includes a letter from the President indicating that it is a patriotic duty to continue normal education, unless required for special war work. Looking ahead, one might say that it is the business of education everywhere to prevent, if possible, the occurrence of another war. An ingenious graph arranged in ascending rows like a typewriter shows with commentary the increases and decreases in various grades of school attendance. "Radio in Schools and Colleges" recognizes that it cannot, alone and unaided, do much more than stimulate. There are no short cuts to learning, except in the optimistic promises of the world of advertisement. Teachers can learn more than pupils, but among the 360 colleges offering radio courses only one in twenty is designed for them.

There are good, long articles in *School and Society* on up-to-date ideas of the educated man, the prospects of education for war, with the mistakes of the past, on which, we note, all are not agreed, and the world the high school has to face to-day. A letter on "The Teacher's Professional Life" suggests that he should attend conventions, where he can exchange views about his 'shop'. It is important also that he should not confine himself to going about with other teachers and lose touch with the rapidly changing world which supplies his pupils and challenges him to produce good results for democracy. A plea for a better vocabulary among college seniors is interesting. But a "planned, concerted drive" may be less effective than good example, which leads to a tradition of using language carefully and well. A mark of the good speaker is his choice of adjectives.

British Electrical and Allied Industries Research Association

THE twentieth annual general meeting of this Association was held on February 14, when the annual report was presented. In a foreword written by the chairman of the council, Mr. C. W. Marshall, of the Central Electricity Board, many interesting remarks about research are made. He points out that research is rarely spectacular to the layman; but owing to the steadily increasing importance to the industry of the activities of the E.R.A., it is now widely appreciated. Mr. Marshall said he has followed the development of the Association from its inception, especially in its relation to electricity supply. Three classes of investigation pursued in the Association's laboratories and elsewhere have been of special interest to him because of their vital importance to the electrical welfare of Great Britain: these are the investigations into circuit-making and breaking, surge phenomena, and properties of insulation.

The search for the most effective and economical types of circuit-breaker has been one of the most difficult and interesting investigations in the history of electrical engineering. To-day, the essential basic phenomena are well understood, at least by switchgear specialists, and circuit-breakers which are to all intents and purposes free from the formerly dreaded fire and explosion risks are available for all applications. The E.R.A. has played a leading part in this development. Lightning research has been a less urgent matter because of the comparatively small incidence of lightning faults in Great Britain. It was nevertheless appreciated that these faults had to be eliminated, and a systematic scheme of investigation was drawn up several years ago. An important stage of the work will be marked by the publication in due course of an E.R.A. compendium of information on surge phenomena, and by the introduction of a commercial model of the E.R.A. surge filter for protecting electrical equipment against damage from lightning. E.R.A. investigations into the properties of electrical insulating materials are helping to make the fundamental discoveries of atomic physicists available to the practical electrical engineer.

Rocket Flight to the Moon

CONDITIONS of life on this earth may turn the thoughts of the escapist to contemplation of other heavenly bodies. For nearness, the moon has much to commend it. The problem of the means of transport still remains. If rocket flight be chosen, J. W. Campbell's recent paper (*Philosophical Magazine*, January 1941) will be found to give considerable help. Special attention is given to the type of flight in which the observer moves with a massive body from which rockets are fired at intervals in directions suitably controlled to guide the main body. Assuming an initial velocity more than twice that of the present muzzle velocity of artillery shells (2500 ft./sec.), a calculation is made of the *minimum* mass of the moving "rocket ship". The result is 2×10^{-9} of the earth's mass. If the mass were distributed as a homogeneous sphere of material of density about

that of surface rock (3·3), then the radius of the sphere would be about 2·74 miles. Relevant factors, such as the atmospheric resistance and the control of direction, have been neglected. If they were taken into account, the initial mass would be still greater. On these calculations the rocket ship would be more than five miles in diameter, and would be as massive as Mount Everest.

Mammals and Man

WITH the view of adding definiteness to the rather vague popular ideas of the class of mammals, the Zoology Department of the National Museum of Wales has set up a temporary series of exhibits for which a descriptive pamphlet, "Mammals and Man", has been written by the keeper of the Department, Colin Matheson (pp. 22. 3*d*.). The exhibits show representatives of the main groups of mammals, and indicate some of the ways in which mammals contribute to the welfare of humanity. Thus it is pointed out that of 3,500 known species of mammals, only about twenty have been thoroughly domesticated, and some of the breeds of the most familiar animals are illustrated among the exhibits. The economic products of the group are represented by wools of various kinds, by furs, particularly dressed furs made from rabbit skins, leather, many products of bones, food materials and so on. The arrangement follows the economic zoology which was a popular diversion of last century, but we miss references to modern developments such as the varied and most important uses of whale oil, the increasing resort to mammal products in biological therapy, and the importance assumed by mammals as reservoirs of disease organisms of man or domestic stock, as in the case of cattle disease in Africa, or as the carriers and communicators of disease, as in the case of the vampire bat. This exhibition, and all such special exhibitions, will do much to keep alive general interest in museum collections, which are always in danger of becoming static and unenterprising.

Mounting Museum Specimens in Plastic

ONE of the great handicaps in making attractive to the ordinary museum visitor specimens of the smaller organisms has been the need for mounting such in formaldehyde, alcohol, or other fluid, which almost invariably bleaches colour and makes necessary awkward methods of attachment. To a considerable extent that difficulty has been overcome by the use of an acrylic resin, 'Plexiglass', the product of experiments conducted by Dr. Otto Rohm, of Philadelphia. Dr. Charles E. Sands, of the Bureau of Agricultural Chemistry and Engineering, has developed a method of embedding specimens in blocks of this material so that they resemble fossils preserved in amber, except that 'Plexiglass' is colourless and crystal-clear, clearer it is said than the finest glass, and will retain its transparency permanently. Specimens before embedding must be dehydrated in air or with alcohol or dioxan, and the setting is done in vacuum to prevent the inclusion of air-bubbles while the mountant is changing from semi-fluid to the solid state. A collection of miscellaneous specimens mounted in this way was on view at the New York World's Fair, and is permanently shown in the Franklin Institute in Philadelphia.

Fertility Rules in Fruit Planting

THE John Innes Horticultural Institution has produced a very useful leaflet (No. 4) with the above title, which sets out clearly the rules for interplanting fruit trees to ensure effective pollination. Based on many years of research to test the success of crosses between varieties of cherries, plums, pears and apples, this leaflet will be an invaluable guide to growers in the planning of new orchards and in the improvement in fertility of existing trees. It is estimated that the value of the total fruit crop of Great Britain could be increased 10–20 per cent by correct interplanting. In some existing orchards containing large blocks of trees of a single variety, much could be done to increase the crop by top-grafting a proportion of the trees with suitable pollinators. Brief reference is made in the leaflet to the causes of unfruitfulness, and exhaustive lists are provided to show which varieties are self-compatible and which varieties will ensure effective cross-pollination. Attention is directed to the reduced population of wild bees in many orchard districts and the necessity for keeping hive-bees in correctly interplanted orchards.

Feeding Value of Silage

FARMERS must be able to judge the feeding value of their silage, and to meet this need the Ministry of Agriculture has issued Bulletin No. 50 in the "Grow-more" series. High-quality silage is a cake substitute and can only be obtained from the right crop, cut at the right time and properly ensiled. The colour, smell, texture and dry-matter content of material in this category are described, and recommendations given as to the rate at which it should be fed. If any of the requisite conditions is not fulfilled, the silage can only be used to replace hay, roots, or oat straw. The value of such material varies considerably according to the type of crop from which it is made, or to the conditions during ensiling, but suggestions are given as to the rationing of several of the low-protein silages. For the less experienced farmer, a useful table is included, in which the common faults in silage, their cause and the appropriate remedy are described, and if still further information is desired, application can be made to the county agricultural organizer.

A New Pavlov Manuscript

MR. M. KRUTIKOV, who is working at the archives of the Academy of Sciences of the U.S.S.R., has discovered the manuscript of a hitherto unknown work by the Russian physiologist, the late Prof. I. P. Pavlov. The work, which had been submitted for a competition for a prize of the Academy, is entitled "The Centrifugal Nerves of the Heart", and it is dated 1885; it consists of 19 pages. It seems that when the manuscript reached the Academy

it was handed for report to I. Tarkhanov, who, after some time, presented a long scientific review of the work. However, he failed to come to any definite conclusions about it, because of the absolute newness of the subject and the absence of any literature on it. It is hoped to include the new paper in the complete edition of Pavlov's works which the Academy proposes publishing.

The Linnean Society of London

GENERAL meetings of the Linnean Society of London are to be resumed at 3 p.m. on the following Thursdays: March 6, April 3, and May 1. On March 6, several papers will be read. The centenary of the Royal Botanic Gardens, Kew, as a Government institution occurs on April 1, and at the meeting on April 3, Sir Arthur W. Hill, director of the Royal Gardens, will give some account of the work of Kew during the past hundred years. At the meeting on May 1, the Society will keep the tercentenary of the birth of Nehemiah Grew, when Dr. Agnes Arber will give an account of him, and of Marcellus Malpighi. The anniversary meeting will be held on May 24, when the president will address the Society. The council is to consider the possibility of prolonging the session into June and July.

Announcements

OWING to the generosity of the Rockefeller Foundation, which has provided a grant for the purpose, the Royal Society is in a position to give some assistance to scientific societies and associations which, as a result of war conditions, are experiencing financial difficulties in the publication of scientific journals.

AMONG the bequests in the will of the late Sir Robert Hadfield, who died on September 30 last, are the following: gold and other medals, diplomas and certificates to the University of Sheffield for any library or museum in connexion with the Faculty of Metallurgy, and failing acceptance, to the Science Museum, South Kensington; his collection of alloy specimens forming the record of his various papers to scientific and technical societies to the Science Museum, South Kensington; £1,000 to the Imperial Cancer Research Fund; £1,000 to the Royal Society for general research work.

DR. J. BURTT DAVY, late University demonstrator in forestry in the University of Oxford, who died on August 20, bequeathed a bond for £7,000, secured on property in the Transvaal, or any of the capital paid, to the Chancellor, masters, and scholars of the University of Oxford, to found a scholarship, "The Burtt-Davy Research Scholarship", for research work in taxonomic botany and/or tropical plant ecology.

THE University of Liverpool is to receive a sum of £2,500, under the will of Mrs. Mary Harmood Hamilton, to endow a scholarship or scholarships in the Faculty of Engineering.

SIR ANDREW DAVIDSON, county medical officer for the North Riding of Yorkshire, has been appointed to succeed Prof. J. Mackintosh as chief medical officer of the Scottish Department of Health.

MR. HECTOR LEAK has been appointed president of the Royal Statistical Society, to hold office until the next annual general meeting, in succession to the late Mr. Henry W. Macrosty (see p. 230 of this issue).

MR. GEORGE GRANT, registrar of University College, Southampton, since 1923, has been appointed registrar of the University of Birmingham to succeed the late Mr. D. J. Cameron. The status and stipend of registrar have been raised to equality with those of full-time professors.

THE journal *Microentomology*, issued from the Natural History Museum of Stanford University (California), is now in its fifth volume. Among recent issues that have come to hand are contributions by Dr. G. F. Ferris and others on the detailed external morphology of selected types of the various orders of insects. These accounts are very clearly illustrated by well-executed figures that are intended to meet deficiencies in this respect in many existing publications. The journal, it may be added, is obtainable from the Director of the Museum, and individual parts are obtainable separately at a low price.

DURING the committee stage in the House of Commons of the War Damage Bill, Sir William Jowitt said, in reply to an amendment put forward by Mr. K. W. M. Pickthorn, one of the representatives of the University of Cambridge, that universities must be regarded, for the purpose of the Bill, as carrying on business. That being so, they would not be exempt from compulsory insurance, but he added that the Government would use its powers under the clause to exempt from the obligation to insure certain classes of the non-essential equipment of universities. He expressed the hope that the Government would receive assistance from the universities and their representatives in formulating a workable scheme.

A CATALOGUE of books relating to Egypt recently issued by Mr. George Salby, oriental bookseller, of 65 Great Russell Street, London, W.C.1, has a special association interest for Egyptologists and students of the archæology of the Middle East. It includes the libraries of two well-known archæologists. First that of J. L. Starkey, excavator of Lachish, whose assassination by an Arab brought to a premature close one of the most illuminating of recent archæological excavations in Palestine; and secondly, that of Alan W. Shorter, assistant keeper of the Department of Egyptian and Assyrian Antiquities in the British Museum, whose early death cut short a career of much promise. In addition to books which might be termed the tools of a working archæologist, the catalogue includes a number of rarities, among them Prisse d'Avennes "L'Art Arabe", text with three volumes of 200 plates, Rosellini's "Monuments of Egypt and Nubia", and Arthur Upham Pope and Phyllis Ackerman's "A Survey of Persian Art from Prehistoric Times to the Present", the last-named a monumental and scholarly production.

ERRATUM. In the letter "Rheology of Plastic Materials" in NATURE of February 8, p. 176, for the formula "$\psi = S\sigma^{4\frac{1}{2}}$" read "$\psi = S\sigma^{-4\frac{1}{2}}$".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Legal Protection of the Names of Animal Breeds

VERY often the name of a breed of animal, after being imported into another country, is changed there. This new name given by the importers leads to the impression that the breed is a new one and of native origin, for which the importer unfairly claims the credit, whilst it is really a foreign race. One must consider that this manner of appropriating the work of another is a fraud, and should be treated as such, just as literary plagiarists are punishable by law. Neither can the products of grading be regarded as a new race. It would be better to name the first generations of grades according to their different amounts of blood with regard to the polygenic characters, just as horse grades, for example, are called: ½-, ¾-, ⅞-, $\frac{15}{16}$-blood. As regards the following generations, closely resembling the pure breed of livestock, they should be given the name of the race used for grading, together with the name of the region where the rearing took place, as in the imaginary example: Southdown of Holstein. This name would describe a race of sheep bred in Holstein, being the result of grading native sheep with pure-bred Southdowns.

For the countries which export breeding stock it is of great economic importance to have the names of animal races protected legally. There are many cases known in which animals were imported to another country, multiplied and then advertised as new breeds and sold to another country again. Or in other cases crossbreds produced in some countries by crossing British or Swiss breeds with native stock were sold as pure-bred British or Swiss or under a changed name, as a new breed. These products, being crossbred, had no real breeding value.

This problem has a domestic importance in every country, and not only in connexion with the export of breeding stock. Some people lay claim to be creators of new breeds, simply by making single or double crosses of different existing breeds.

From the scientific point of view, it is also very important to know the origin of every breed, and the crosses used to develop a new type or breed. The use of genetical methods to improve animal breeding would be much easier if the origin of many breeds were not obscured, as is often done purposely.

In order to direct attention to this problem, which is so important to breeders and to the science of breeding, I read a paper at the Fourth International Congress on Animal Breeding in Zurich in July 1939, under the title "The Protection of the Denomination of Animal Races by Law". Afterwards I proposed to the Congress that it should pass a resolution to protect legally the names of animal races, a protection which would be of great value and importance not only from scientific, but also from economic and moral points of view. After a very lively discussion, the resolution was passed to put the matter in the hands of the "International Association for Animal Production" to be constituted. (See Proceedings of the Congress, Zurich, 1939, pp. 333 and 403.)

The subsequent breakdown in international relationships has arrested this promising start. It is in any case very desirable that a *controlling body should be established* in every country engaged in producing and exporting the breeding stock. The same body, it is proposed, should also have the power to decide when a new breed has been developed. The question of whether or not a group of animals could be called a new breed needs careful and individual consideration; every case should be judged on its merits.

The interests of Great Britain in this matter being so considerable, it seems especially needful to establish such a regulatory organization in this country, possibly with others in the Dominions. If other countries do establish similar controlling bodies, the question of linking them up and integrating them could usefully be gone into after the War as a preliminary to the resumption of international trade in breeding livestock. It would be fitting for Great Britain to take the lead.

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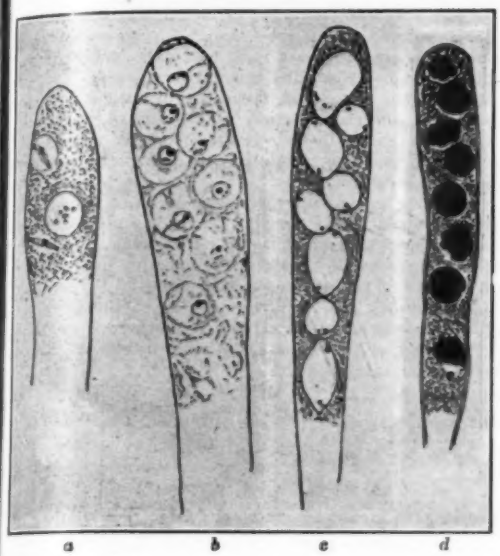
Jan. 25.

Ascospore Dimorphism of *Bulgaria inquinans*, Fr.

THE adult ascus of *Bulgaria inquinans* typically contains eight spores, four of which are large, dark and thick-walled, the rest being small, thin-walled and hyaline.

According to Moreau[1], the explanation of this dimorphism is to be found in the earlier development of the ascospores. He alleged that the three successive divisions of the definitive nucleus of the ascus were not synchronous, and this resulted in a precocious development of four of the ascospore nuclei. Then, during the subsequent differentiation, these nuclei became invested with a greater quantity of sporeplasm than the remainder, the final result being a spore dimorphism.

During an investigation of the cytology of this fungus, in the course of which two reduction divisions were observed in the earlier development of the ascus, a number of observations upon the development of



a b c d

the ascospores was also made. None of these was in agreement with those of Moreau. No asynchronism of the mitoses in the ascus was observed, the number of nuclei present was always one, two, four or eight, indicating that the divisions were quite regular. The phases of the divisions were nearly always synchronous also, as is seen, for example, in the metaphases of the last meiosis, three of which are shown in the accompanying figure (*a*).

The mode of spore delimitation involving the participation of a nuclear beak and astral rays was quite normal, and at the time of the formation of the spore membranes the ascus contained eight isomorphic uninucleate spores. At this time also the ascospores passed from an ellipsoid to a spherical form (*b*). It is subsequent to this condition that the dimorphism begins. Four of the spores increase in volume and become ellipsoidal again, the others undergoing very little further increase. After the dimorphism has been established and the spores are assuming their final form, the nucleus of both types divides so that each is at least binucleate in the mature condition (*c*). The dimorphism here is thus dissimilar from that found occasionally in *Neurospora tetrasperma* (Colson[2]) and some other fungi, where the large spores are binucleate and the small uninucleate, since in the former the initial condition for all the spores is a uninucleate one, whereas in the latter the larger spores are initially binucleate.

An examination of asci in which the fatty material of the spores had been blackened by the osmic acid in the fixative showed that in young asci where there was as yet no external dimorphism, the arrangement of the osmicated droplets fell into two classes (*d*). They appeared in four young spores as flocculated and in the other four as consolidated masses, and an examination of even earlier stages showed that the latter was a condition derived from the former. The four spores containing the condensed fatty material increased in size and finally developed the thick brown walls characteristic of the large type. At the same time the osmicated substance increased in amount, finally breaking up into a small number of large droplets. No alteration from the original condition was observed in the small spores.

On account of the correlation between the above changes and the development of the dimorphism and the inability to support Moreau's conclusions, it is suggested that the cause of the condition is to be sought in a difference in the fat metabolism of the two spore types. In other words, the explanation is physiological rather than cytological.

A full account of this investigation will be published elsewhere.

C. L. FOSTER.

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University,
Leeds.
Jan. 17.

[1] Moreau, F., *Bull. Soc. Mycol. France*, **30** (1914).
[2] Colson, B., *Ann. Bot.*, **48** (1934).

Inhibition of Nitrification by Chromates

THE occasional presence of chromates in sewages which receive discharges of trade effluents from the chromium-plating industry led us to investigate the influence of chromate on sewage purification processes. Samples of sewage containing sufficient potassium chromate to provide 1, 10 and 100 mgm. chromium per litre of sewage were treated in laboratory percolating filters, and comparisons were made with a control filter. The results, already published[1], showed the oxidation of organic matter proceeded satisfactorily with up to 10 mgm. chromium per litre, but that nitrification of ammonium compounds did not occur to the same extent as in the control filter.

In continuation of these experiments, the effect of chromates on the purification of sewage by activated sludge is now being studied. The activated sludge was built up by aerating domestic sewage until a sludge was produced capable of completely oxidizing 40–50 mgm. ammoniacal nitrogen per litre to nitrate within 12 hours at 18–19° C. When aerated with sewage containing potassium chromate equivalent to 10 mgm. chromium per litre, part of the activated sludge failed to produce nitrate within 24 hours, but instead nitrite was formed. Within 48 hours, following a second addition of sewage containing 10 mgm. chromium per litre, formation of nitrite and nitrate ceased: aeration with fresh additions of sewage without chromate failed to cause oxidation of ammonium compounds within a period of eight days. Other experiments with the nitrifying sludge showed that three charges of sewage containing 5 mgm. chromium per litre added on successive days was enough to arrest nitrification. The same phenomenon as before was observed, namely, that the sludge after contact with chromate did not recover its power of nitrification after aeration with sewage for one week.

The study of further aspects of this subject is now in progress, but it seems worth emphasizing that not only is the activity of organisms concerned with the production of nitrite and nitrate from ammonia arrested in presence of small concentrations of chromate, but also that the inhibitory action appears to last for a considerable period after removal of this inhibiting agent. Although nitrified effluents are not obtained by aeration with activated sludge in

presence of chromate, it is still possible to obtain effluents which in every other respect are well oxidized and of high purity.

Birmingham Tame and Rea District Drainage Board, Rookery Park, Birmingham, 24. Feb. 6.

S. H. JENKINS.
C. H. HEWITT.

[1] Jenkins and Hewitt, *J. Soc. Chem. Ind.*, **59**, 41 (1940).

Origin and Nature of Heavy Ionization Particles Detected on Photographic Plates Exposed to Cosmic Rays

IN a previous communication[1] we gave an account of star-like tracks obtained in vertically placed Ilford Halftone plates exposed to cosmic rays at Sandakphu (3660 m.) and Darjeeling (2130 m.). We suggested that they were due to secondary mesotrons. Since then we have carried out a more detailed examination of these plates and also of other similar plates kept at Sandakphu for 202 days (i) under 20 cm. of water in a galvanized iron box, (ii) in a lead box with 5·5 cm. lead on the top of the vertically placed plates. The last-named plates on development were found to be fogged. Fortunately, the observations of Heitler and his co-workers[2] on similar plates exposed under different thicknesses of lead at Jungfraujoch supplement our observations and are in agreement with our results.

(I) In the course of our examination of the exposed photographic plates during the last year and a half, we observed a number of curved tracks on them. Our experience with proton tracks produced on similar plates led us to the view that the former could not be due to protons but were probably due to mesotrons. To test this point we exposed a Halftone plate to fast neutrons due to a radium-beryllium source, with 10 cm. of lead to cut off the gamma rays. Fast protons are produced in the material of the film due to collision of the fast neutrons with hydrogen atoms in the latter, and proton tracks up to 40 cm. air range were observed. The total range in air, the mean particle distance and the total angle of scattering of the cosmic ray and proton tracks are given in Table 1.

TABLE I

Track No.	Total air length	m.p.d.	No. of curved tracks	Sum of scattered angle
A. Sandakphu (air)				
1–22	380 cm.	5·5 μ	4	19°
23–45	356	4·2	9	57°
46–77	396	3·4	12	61°
78–87	107	2·7	2	12°
B. Proton tracks				
1–74	1111 cm.	2·6	2 single scattered 1 curved	

According to the theory of nuclear multiple scattering of charged particles, the mean deflection $\bar{\theta} = \frac{Z z e^2}{W} (Nt)^{1/2}$ (3·69 + a log. correction term), where Z and z are the atomic numbers of the scattering and scattered particles, W the kinetic energy of the latter; that is, the scattering varies as $1/v^2$ of the particles. On the other hand, it is found empirically, and this result finds reasonable interpretations in the theory given by Helens and Wilkins[3], that the mean particle distance along the ionization tracks in photographic emulsion increases with the velocity of the particle, that is, the faster particle will be characterized by greater m.p.d. and smaller scattering. Judged according to this criterion the cosmic ray particles and the protons cannot be of the same kind, and assuming that they both carry the same charge, the former has a smaller mass than a proton. In view of the fact that we and also other investigators have failed to observe discrete tracks on photographic emulsions due to fast electrons, it can be reasonably concluded that the tracks recorded in Table 1 *A* are due to mesotrons.

(II) Absorption in water and air: In Table 2 is given the number of tracks observed in photographic plates kept at Sandakphu and Darjeeling under different conditions. To obtain a measure of the energy of the cosmic radiation, we have counted the number of tracks per cm.[2] on the plates, excluding those tracks in which the mean particle distance is less than 2·2μ, as experience shows that such tracks are due to α-particle contamination.

TABLE II

	Plates kept under	No. of tracks per cm.^{2}/100 days	No. of tracks absorbed due to	Ratio of absorption
Sandakphu	(i) air	165	20 gm./cm.^{2} water	
	(ii) 20 cm. water	67	98	1·6
Darjeeling	(iii) air	103	140 gm./cm.^{2} air 61	

The conclusion can be drawn that the component of the cosmic ray responsible for producing heavy ionization tracks in photographic plates is more strongly absorbed in water than in air and that it is probably neutrons. The relative energy loss due only to elastic collision in the given masses of water and air of the high-energy neutrons responsible for multiple shower production, can be calculated from the following consideration. A neutron during such a collision with an atom of mass M loses on an average $2/M$ of its energy; that is, it requires $M/2$ collisions to produce the same loss of energy as collision with a hydrogen atom. We can then calculate the number of equivalent hydrogen collisions in the two media, and their ratio comes out 1·7, which is very near the observed value of 1·6.

The agreement between the two (if not accidental) can be made plausible on the following assumptions: (i) such high-energy neutrons are very seldom produced in the mass of air between Sandakphu and Darjeeling; (ii) the cross-section for elastic collision is large compared with that for shower production; and (iii) on an average they do not suffer more than one hydrogen-like collision.

According to the older perturbation theories of Bhabha and Heitler, the scattering cross-section of fast mesotrons by protons increases with the mesotron energy and is independent of the proton mass. The first of these conclusions and the order of magnitude of the scattering cross-section is not in agreement with experimental results. According to the revised theories proposed by the same authors[4,5], the calculated scattering cross-section is in agrement with the observed results, but the production of multiple mesotron showers is not possible according to it, while the older theory could account for it. Our results are thus not in agreement with the predictions of the newer theories. A recent theory of Heisenberg[7] appears to give a reasonable picture of multiple shower production by the impact of fast neutral particles on neutrons and protons; according to this view, the scattering cross-section of mesotrons diminishes with the increase of proton mass and has a much smaller value for high energies than that given by the older theory.

(III) We do not feel competent to judge the validity of the assumptions underlying the different theories; we have, however, tried to verify one consequence of the new theory proposed by Bhabha, according to which the following reaction is possible: $p+p \rightarrow p_3+n$. the minimum energy required is 35 Mev. and the cross-section for such a process is $3{\cdot}2\times10^{-28}$ cm.², which is expected to occur when a fast proton traverses about 45 cm. of water. We have examined the plate kept under 20 cm. water for 202 days for tracks of such double-charged protons. The latter will ionize like α-particles, and in order to distinguish them from the latter we have looked for such dense tracks of length greater than 10 cm. of air. In an area of 1·05 cm.², no such track was observed. The negative result may be due to the small number of high-energy protons present in the cosmic ray.

We are indebted to Dr. R. C. Mazumdar for directing our attention to Bhabha's paper.

Bose Institute, 93 Upper Circular Road, Calcutta. Nov. 12.

D. M. BOSE.
BIVA CHOWDHRY.

[1] Bose and Chowdhry, NATURE, **145**, 894 (1940).
[2] Heitler *et al.*, NATURE, **144**, 283 (1939); **145**, 65 (1940).
[3] Williams, *Proc. Roy. Soc.*, A, **169** 531 (1939).
[4] Helens and Wilkins, *Phys. Rev.*, **54**, 783 (1939).
[5] Bhabha, *Proc. Ind. Acad. Sci.*, A, **11**, 346 (1940).
[6] Heitler and Ma, *Abst. Proc. Roy. Soc.*, July 18, 1940.
[7] Heisenberg, *Z. Phys.*, **113**, 61 (1939).

Effective Frequencies of Sensitive Flames

BROWN[1] showed in 1932 that if a graph of flame-height against frequency of the sound were plotted, there occurred a large number of maxima and minima, and that the frequencies of these maxima and minima were independent of the gas velocity, the shape and size of the jet, and the amplitude of the sound; and further, that those for hydrogen were indistinguishable from those for coal-gas. From his theory of edge-tones he has recently concluded that the reaction of the external air (the only constant factor) cannot be neglected[2]. In order to exclude the effects of resonance of all kinds, Brown repeated his experiments with entirely different apparatus in a different laboratory, but the frequencies remained unaltered.

Some recent observations of mine support Brown's results. They were made in the Department of Applied Physics in the University of Basle in Prof. Zickendraht's laboratory. The apparatus consisted of a Siemens-Halske oscillator, an amplifier and a 'Blue Spot' loud-speaker. Differently shaped brass jets were used, and the response to the sound was observed by measuring the change in the height of the coal-gas flame. The change in output of the oscillator-amplifier set was checked by a galvanometer placed in series with the moving coil of the loud-speaker, and care was taken to ensure that any maxima and minima of the output were eliminated by a sliding resistance.

It was found that the occurrence of the main maxima and minima of response depended only upon the frequency. The main minima were at frequencies of 1,200, 1,490 and 2,140, and the main maxima at 1,180, 1,470, 1,680 and 2,960. Comparison with Brown's detailed results shows good agreement. No marked maxima or minima occurred at higher frequencies with the jets used.

It seems, therefore, that, difficult as these results are to explain theoretically, they cannot be attributed to resonance either in the laboratory or in the apparatus.

PETAR SAVIC.

University College of London, at the University College of North Wales, Bangor.

[1] Brown, G. B., *Phil. Mag.*, **13**, 161 (1932).
[2] Brown, G. B., *Proc. Phys. Soc.*, **49**, 519 (1937).

Glaisher's Table of Powers

Is there any contemporary of Dr. J. W. L. Glaisher who can throw light even now on the mystery of his suppression of completed tables? The basis of the Table of Powers just published by the British Association [see p. 219 of this issue of NATURE] is a table of the first twelve powers of the first thousand integers compiled by Glaisher. This table was finished in 1873 and was stereotyped, but it was not published. The plates were presumably destroyed, and the proofs seem to have been systematically hunted down. One copy survived in secret; Mr. H. J. Woodall found it among papers left by Lieut.-Colonel A. J. C. Cunningham, recognized its value, and presented it in 1935 to the British Association Tables Committee.

A similar story is attached to the Number-Divisor Tables prepared last year by the same Committee. Glaisher completed a set of tables for the Cambridge Philosophical Society in 1884, type was set up, plates made, and proofs pulled, and there the matter rested until ten years after Glaisher's death.

Also among Glaisher's papers were found volumes of manuscript tables of four theta functions, the denominator and the three numerators of the Jacobian elliptic functions, computed at degree intervals of the modular angle. This is an enormous piece of work, and apparently Glaisher was content that nobody should benefit from it. Why?

It is easy to account for the abandoning of an unfinished enterprise. The only obvious reason for the suppression of a finished table is the discovery of a systematic error, and Glaisher had not this reason. The British Association Committee submits all its material to the most drastic checks, and Glaisher's work was almost perfect: a missing digit in one table, a few accidental errors that his own process of checking would have detected in another, is the whole tale of faults.

In the preface to the Number-Divisor Tables, I wrote: "It is as if Glaisher knew too well the distance that separates accurate manuscript from faultless print, and could not force himself to the irrevocable step of authorizing publication". But this is sheer conjecture. Can no mathematical confidant, no reluctant printer, speak from knowledge?

E. H. NEVILLE.

University, Reading.

Sir J. J. Thomson, O.M.

I AM collecting material for a life of the late Sir J. J. Thomson, master of Trinity College, Cambridge. If any readers of NATURE have letters from him containing matter of interest, I should be very grateful for the loan of them. They would be copied and returned as soon as possible.

RAYLEIGH.

Terling Place, Chelmsford, Essex.

ORIGIN OF METEORITES

IN the Halley Lecture* of 1940, Prof. F. A. Paneth presents a most stimulating and informative survey of the many hypotheses that have been proposed in the attempt to solve the difficult but fascinating problem of the origin of meteorites, with special reference to the evidence on which modern views are based.

In addition to the accepted groups of 'irons' and 'stones', Paneth follows Suess in claiming 'glasses' (tektites, etc.) as meteorites—despite the fact that no actual fall of tektites has been reliably observed—on the ground that, since hypotheses explaining the occurrence of tektites as products of human manufacture or as terrestrial formations can easily be disproved, there is no alternative but to assume that they are of celestial origin. Moreover, the hypothesis of Michel, adopted by Lacroix, that tektites are formed in the atmosphere by the oxidation of silicon and other elements, is disproved by the fact that the rapid flight through the atmosphere of these alleged elements would allow far too little time for reaction with the enormous volume of oxygen that would be required. Paneth throws out the suggestion that silica-rich granitic bodies representing the original material of the tektites may have entered the Roche limit of the sun and there suffered melting and dispersal, to form swarms of glass globules on cooling after leaving the perihelion neighbourhood. It has, of course, to be recognized that our interpretations of the origin of iron and stone meteorites may not apply to the glasses. In this connexion it is relevant that while there are transitional varieties between the first two classes, there is none whatever between either of them and the third. In what follows, therefore, reference is made only to iron and stone meteorites.

Evidence consistent with the origin of meteorites in the solar system is: (*a*) The close geochemical analogy between meteorites and terrestrial materials, even to the minor chemical elements and their distributions. (*b*) The identity in isotopic constitution of all the meteoritic elements so far tested with those of the corresponding terrestrial elements; this applies even to the radioactive elements uranium and potassium, and since the isotopic ratios of a radio-element vary with time, such identity points to the simultaneous origin of both meteoritic and terrestrial uranium and potassium. (*c*) Paneth's own determinations of the ages of iron meteorites, none of which is of a higher order than that now assigned to the earth: here it must be noticed, however, that with the coming into favour of the 'short' time-scale of the universe this item of evidence can no longer be claimed as an argument against an extra-solar origin for iron meteorites.

The chief astronomical arguments bearing on the birth-place of meteorites depend upon observations (*a*) of the orbits and velocities of falling meteorites; and (*b*) of the distribution of meteorite falls during the hours of the day. In a few cases heliocentric velocities have been recorded which are sufficiently high to imply an interstellar source for the meteorites concerned. Hoffmeister has, indeed, declared that the interstellar origin of a majority of meteorites is a "well established fact", and the preliminary results of Opik's researches at Arizona seem to support this claim. The evidence, however, is conflicting, and the validity of deductions from purely visual observations has been seriously questioned. Paneth refers to recent photographic studies by F. L. Whipple on nine sporadic meteors, which proved that at least eight, and perhaps all, were moving in elliptical orbits; he also cites the opinion of Fletcher Watson and C. C. Wylie that visual observations are inevitably subject to a systematic subjective error which always leads to the over-estimating of velocities. Clearly the interstellar hypothesis cannot be regarded as 'well established' and it is still more gravely weakened by the other line of astronomical evidence, which supports the alternative view that meteorites originated in the solar system. It is found that a majority of the meteorites seen to fall strike the earth between noon and midnight, and from this preponderance it can be inferred that most, and possibly all, meteorites move in 'direct' orbits. Niessl has argued against the validity of this inference, but Lindemann has in turn convincingly disposed of Niessl's objection. Summing up the whole position, Paneth thinks we may safely assume that meteorites have been members of the solar system since their formation.

Other points of interest discussed in the lecture refer to the conditions under which meteorites may have been formed and to their subsequent history. Recent attempts to reproduce the Widmanstätten structure show that it is not formed during solidification from a molten mass; but is due to a later re-orientation of the iron and nickel atoms which occurs while the crystals very slowly cool. The perfection of this structure in iron meteorites implies extremely slow cooling at a relatively high temperature. The parent mass or masses must therefore have had very considerable dimensions, an inference which is consistent with the common view that meteorites may be fragments of asteroids (or of a single asteroid) which came, perhaps several times, within the Roche limit of, say, Jupiter. C. C. Wylie has found that the Pultusk meteorites moved in elliptical orbits resembling those of the small asteroids in their eccentricities, inclinations to the ecliptic, periods of revolution, and mean distances from the sun. The widely varied 'ages' of iron meteorites further suggest that some of the asteroids or their fragments may have passed near enough to the sun to have had their earlier store of helium driven off.

The long and "rather wild" history of stone meteorites which can be read from their intricate structures also points to periodic heating and cooling, and this again suggests close approach, several times repeated, to the sun. Paneth does not overlook the tantalizing complications that this possibility introduces with regard to the development of the Widmanstätten structure. These and other points of detail—such as the origin of chondrules—continue to remain obscure.

Nevertheless, while admitting that the complete story still remains to be told, it is clear that the leading features of the origin of meteorites are now well within our grasp. Prof. Paneth is to be congratulated on a masterly review of a subject to which he himself has made notable and far-reaching contributions.

* The Origin of Meteorites. By Prof. F. A. Paneth. Pp. 26 + 3 plates. (Oxford: Clarendon Press, 1940.) 2s. 6d. net.

THE POPE COLLECTION OF ALCHEMICAL PAINTINGS AND ENGRAVINGS

By PROF. JOHN READ, F.R.S.

THE late Sir William Jackson Pope, professor of chemistry in the University of Cambridge from 1908 until 1939, besides being one of the most eminent of British chemists, was known among the *cognoscenti* as a discerning collector of alchemical paintings and engravings. His treasures included many fine examples, either originals or engravings, of the work of the younger Teniers, Wijck, Bega, Steen, and other painters of the celebrated Dutch school of the seventeenth century. Among other items of much interest there was an unusually complete series of the rich reproductions in mezzo-tint of the paintings of Joseph Wright, the eighteenth-century painter of Derby, whose strangely effective high-lights are seen to such advantage in his representation of the discovery of phosphorus and in his charming study of a philosopher giving a lecture on the orrery.

There was also an impression of the rare engraving on copper, dated 1643, showing the experimenting Franciscan monk, Bertold Schwartz ("Black Bertold"), of Freiburg im Breisgau, "Doctor, Alchimist, und Erfinder der freijen Kunst des Büchsenschiessens, im Jar 1380", firing a charge of gunpowder with a flint and steel in his laboratory. Very exceptionally, the collection contained engravings in both 'enantiomorphous forms' of Teniers' "Le Plaisir des Fous": this famous picture, caricaturing the unintelligent operations of the 'puffers', or exoteric alchemists, depicts an ape seated at an alchemist's hearth with a pair of bellows, the operative paw being the right in one reproduction and the left in its 'mirror-image'. The pair of small engravings, which used to face each other upon the mantelpiece of Pope's study in Cambridge, naturally made a strong appeal to the great master of stereochemistry, who had taken delight for so long in the production of new and startling dextro- and lævo-forms in the laboratory.

One of the most attractive items in the collection was an original oil-painting, "The Chemyst", by Cornelis Pietersz Bega. This used to grace the entrance hall of the owner's Cambridge home, and it came from the Sawbridge-Earle-Drax Collection. Painted on a wooden panel, it is remarkable for the purity of its flesh-tones, its striking light effects, and its delicate tones of heliotrope and blue. An excellent black-and-white reproduction of this picturesque alchemical interior by Bega adorns the cover of a recent issue of *The Laboratory*, an interesting advertising periodical published in booklet form by the Fisher Scientific Company of Pittsburg, Pennsylvania.

Some time after the death, in October 1939, of Sir William Pope, his collection was acquired by the Fisher Scientific Company; having survived the perils of an adventurous passage across the Atlantic, it is now safely deposited at Pittsburg in the well-known Fisher Collection of notable pictures dealing with alchemy and historical chemistry. The Fisher Scientific Company has combined enterprise with good fortune in securing this handsome accession, and the pleasing thought is worthy of expression that the Pope Collection will preserve its identity in the new milieu.

It is a sign of the great interest taken by American chemists, both academic and industrial, in the historical evolution of their science that an American industrial corporation should take such pains in building up a purely historical collection of the kind under notice. While congratulating the United States most cordially on her clear vision and good fortune in this matter, all British chemists who appreciate the interest, inspiration and educative value of historical chemistry will entertain a feeling of regret that a collection of such outstanding merit as that of Pope could not have been preserved in Cambridge.

These beautiful alchemical paintings and engravings, together with the fascinating collections of drug jars and ornamented mortars brought together by the same hand, would have formed an artistic and unique addition to the Fitzwilliam Museum, besides providing a memorial truly characteristic of Sir William Pope, who accomplished more for the Cambridge school of chemistry than any other man.

EXCAVATIONS AT ELMSWELL, EAST YORKSHIRE, 1938

EXCAVATIONS on the Roman site at Elmswell, carried on by A. L. Congreve in 1936–37, were continued by Philip Corder in 1938 (*Hull Mus. Pub.*, No. 207; 1940). In the earlier investigations finds were both plentiful and remarkable, including thirty-seven coins ranging from one of the Iceni, coins of the whole Roman period and a barbarous type resembling a *sceatta*, pottery unstratified, but of the whole Roman period in the north, ending with an extensive collection of late fourth century ware, the earliest decorated Samian being of the period of Domitian, and stamped Saxon sherds; and a large pile of iron slag, estimated at half a ton in weight, "the product of direct reduction of fairly pure iron ore", which is similar chemically and petrographically to other Romano-British slag. The varied nature of the finds indicated a long period of occupation, which from other finds in the neighbourhood, evidently extended over an area of some square miles from the Bronze Age until Saxon times.

In 1938 a much wider area was trenched—in all about two acres. Ditches were traced, several areas of cobbling or roughly laid chalk blocks were uncovered and one hut floor was examined in detail. No stone-built house of Roman date—the principal objective—was discovered. Three more pits, similar to those already recorded, were excavated, and trenching on the triangular promontory some way from the main site revealed a solitary kiln.

The ditch proved to be shallow and not more than 8–9 ft. across. It must be interpreted as a boundary rather than a defence. Parallel to this, but 108 ft. to the east, was a second ditch, which must be considered part of the same system. All signs of occupation—

huts, floors and pits—lie to the north-east of this system. It is therefore improbable that an undiscovered Roman villa lies westward of the site.

In an otherwise undisturbed area south of the stream, a small kiln was discovered which, from the absence of a stoke-hole pit such as is found in a pottery kiln, is thought to have been an oven for roasting or drying wheat before storage. No part of the superstructure, if any, remains. Sherds found in or near the kiln need not be later than A.D. 120 or thereabouts, and two may be so early as the first century A.D.

Six pits have now been found. Two are double with a central ridge or division separating two hollows. All are relatively large, the largest being 17 ft. 3 in. in greatest length, and 9 ft. 4 in. in greatest width. Every one had been deliberately filled in by tipping in large quantities of wood-ash and dark soil containing charcoal and potsherds. Three were sealed or partially sealed by humps of clay burnt to brick-like hardness. These may have come from ovens or kilns. All are interpreted as storage pits, but two may possibly have been working hollows. The pottery from the pits is of mixed dating. The earliest indicate a date of first occupation late in the first century A.D., while the absence of Signal Station types show disuse before A.D. 370.

It is concluded that the site is that of an insignificant Iron Age village inhabited apparently without interruption from about the middle of the first century A.D. until at least A.D. 500. The chief occupation of the inhabitants was the production of corn. A kiln for the drying or parching of corn, working places where it was prepared for storage, pits for its preservation and an exceptionally large number of hand querns for its grinding are ample evidence for this. In addition, there are unmistakable signs of iron working. Lumps of iron slag on analysis and comparison with known Roman iron slags leave no doubt at all that it is a bloomery slag.

Evidence of regular habitation begins in the first century A.D. A fine piece of *repoussé* bronze work associated with *champlevé* enamel is to be placed in the third quarter of that century. From the pottery it would appear that the Parisii folk who lived here could afford to supplement their home-made pottery by acquiring Roman utensils almost as soon as these were available in the north after the conquest of the Brigantes and the permanent establishment of the Ninth Legion at York. From that time until the end of the fourth century there is no sign of a break in continuity of occupation as attested by coins or pottery. It is possible that occupation continued uninterrupted into pagan Saxon times. Sherds and small objects may date so late as A.D. 500. Hybrid types have suggested "Romano-British women making pots in the Saxon manner for Saxon masters". It is on such a site as this that one might find the enslavement of a sub-Roman population. Not deeply Romanized, they would change masters without serious dislocation in their way of life.

The panel of Celtic ornament from Elmswell, a remarkable example of Celtic art, which was found in 1938, is described by Philip Corder and discussed by C. F. C. Hawkes (*Hull Mus. Pub.*, No. 209; 1940). As it was unstratified and unassociated, its dating depends entirely on internal evidence. It consists of a thin sheet of bronze covered with an embossed design of flowing curves garnished with rosettes, and fitting on, along its upper edge, to an oblong cast-bronze strip decorated with champlevé enamel of a bright orange-red colour, in large part now discoloured green. Beneath comes an iron plate, now incomplete and corroded, which has been bent along its lower margin to form a flange. In all probability it is a panel which ornamented a wooden box or casket. Its dimensions are: length, 5 in.; breadth, 3·1 in. On technological, stylistic and historical grounds, it is assigned to British workmanship under Belgic-Romanizing influence. This conforms to the state of affairs in the Parisian territory of East Yorkshire in, and perhaps some little time after, the second quarter of the first century A.D. The different arguments concerning the style of the panel are summed up as pointing to a date A.D. 50–70, and most probably about A.D. 60 (see also NATURE, **146**, 433; 1940).

FORTHCOMING EVENTS

Monday, February 24

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Surgeon-Commander Murray Levick: "The 1938 Expedition to Newfoundland" (Colour Films).

Wednesday, February 26

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Major C. P. Ackers: "Private Estates and Forestry".

Friday, February 28

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. E. E. Bustard: "Preliminary Calculations in Ship Design".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SPEECH THERAPIST to the Yorkshire (West Riding) Education Committee—The Education Officer, County Hall, Wakefield (February 27).

PUBLIC ANALYST to the Soke of Peterborough County Council and the City of Peterborough—The Town Clerk, Town Hall, Peterborough (endorsed 'Public Analyst') (February 28).

PRINCIPAL of the Brighton Municipal Training College for Women—The Education Officer, 54 Old Steine, Brighton (February 28).

LECTURER IN DIETETICS AND ANATOMY—The Principal, Battersea Polytechnic, Battersea, London, S.W.11 (February 28).

ASSISTANT MASTER (GRADUATE) to take GENERAL ENGINEERING SUBJECTS including ENGINEERING DRAWING AND APPLIED MATHEMATICS—The Principal, Twickenham Technical College, Egerton Road, Twickenham (March 1).

ASSISTANT DIRECTOR at the Anglo-Uruguayan Institute in Montevideo—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Uruguay') (March 1).

GRADUATE (MALE) for the English Room, University of Oporto, Portugal—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Portugal') (March 1).

DEPUTY ENGINEER to the Essex Rivers Catchment Board—The Clerk to the Essex Rivers Catchment Board, Essex Rivers House, Springfield Road, Chelmsford (March 3).

HEADMASTER of the Sunderland Junior Technical School—The Director of Education, Education Offices, 15 John Street, Sunderland (March 10).

LECTURER FOR ENGINEERING DRAWING AND OTHER MECHANICAL ENGINEERING SUBJECTS—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

LECTURER (MAN OR WOMAN) in the Department of Pure and Applied Science—The Registrar, Loughborough College, Loughborough.

THREE ASSISTANT CONSERVATORS OF FORESTS—The Controller, Sudan Government London Office, Oxford Hotel, 261 Clifton Drive South, St. Annes-on-Sea, Lancs. (endorsed 'Conservator of Forests').